

CLIMATE SMART AGRICULTURE

Irrigation Water Management and Technologies – a focus on specialty crops

CALIFORNIA-AUSTRALIA WEBINAR
6/19 (20)/2107



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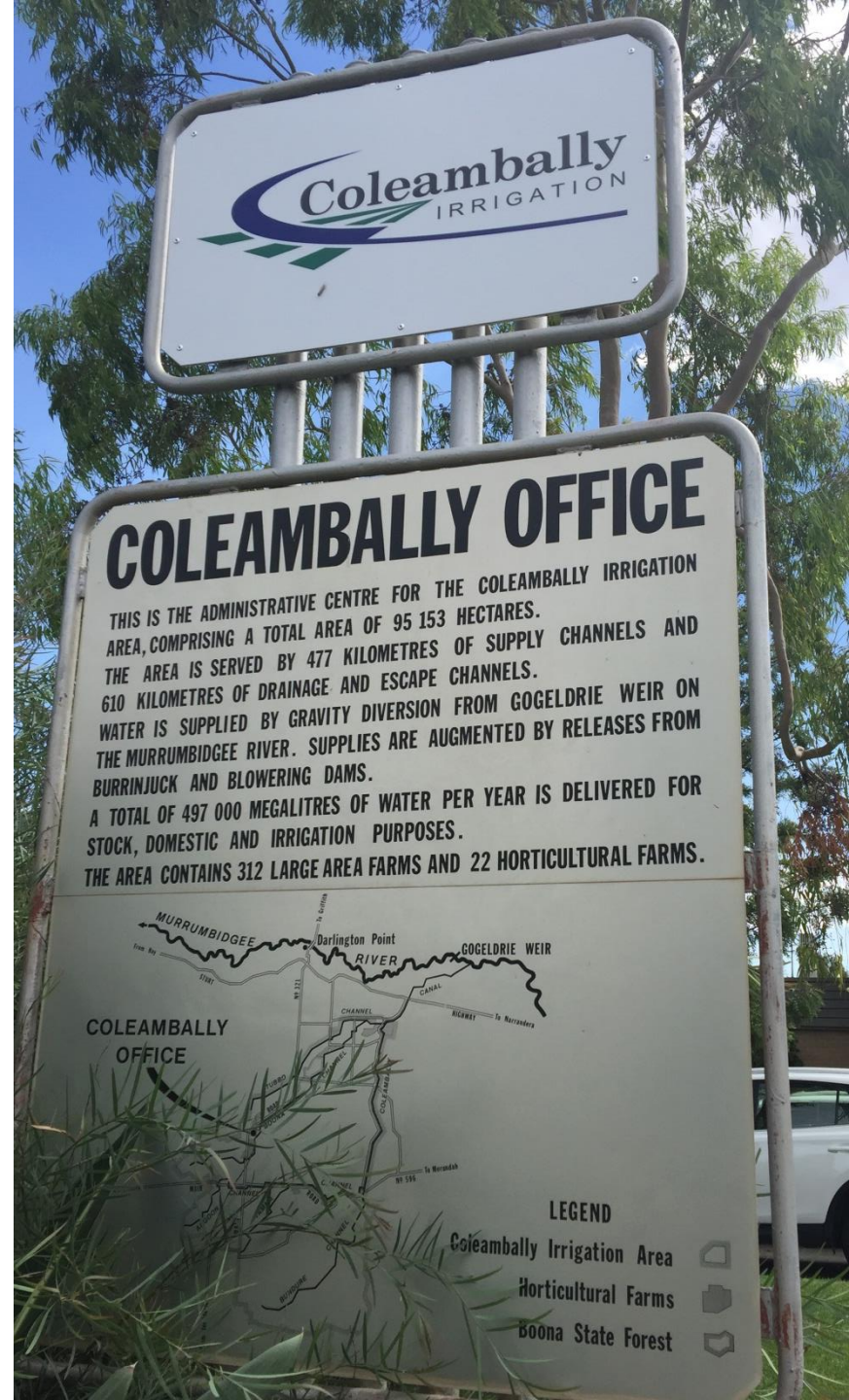
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March 20-25, 2017



Shayleen Thompson, acting CEO
Climate Change Authority, Department of Environment and Energy







PURPOSE OF WEBINAR

Share information on;

- The efficient use of water and technologies for irrigation in Australia and California following historic droughts
- Australian water markets
- Water distribution and technologies at the distribution level
- Water distribution and technologies on specialty crop agricultural operations

WELCOME REMARKS

- Chris Oldfield, Australian Consul-General and Senior Trade & Investment Commissioner San Francisco



- Steven Ostoja, PhD
Director
USDA Climate Hub in Davis



Chris Oldfield

Australian Consul-General and
Senior Trade & Investment Commissioner
San Francisco

Formerly CEO of State owned
Tasmanian Irrigation Pty Ltd



Australian Government
Australian Trade and Investment Commission



Chris Oldfield

Australian Consul-General and Senior Trade & Investment Commissioner, San Francisco

National Water Initiative (NWI) Implementation Plan

Tasmania became a signatory to the NWI on 2 June 2005

The NWI sets out objectives, outcomes and actions for the ongoing process of national water reform and timelines to achieve this reform.

The NWI outlines a number of key areas which will be critical to water reform:

- water access entitlements and planning framework
- water markets and trading
- best practice water pricing
- integrated management of water for environmental and other public benefit outcomes
- water resource accounting
- urban water reform
- knowledge and capacity building
- community partnerships and adjustment

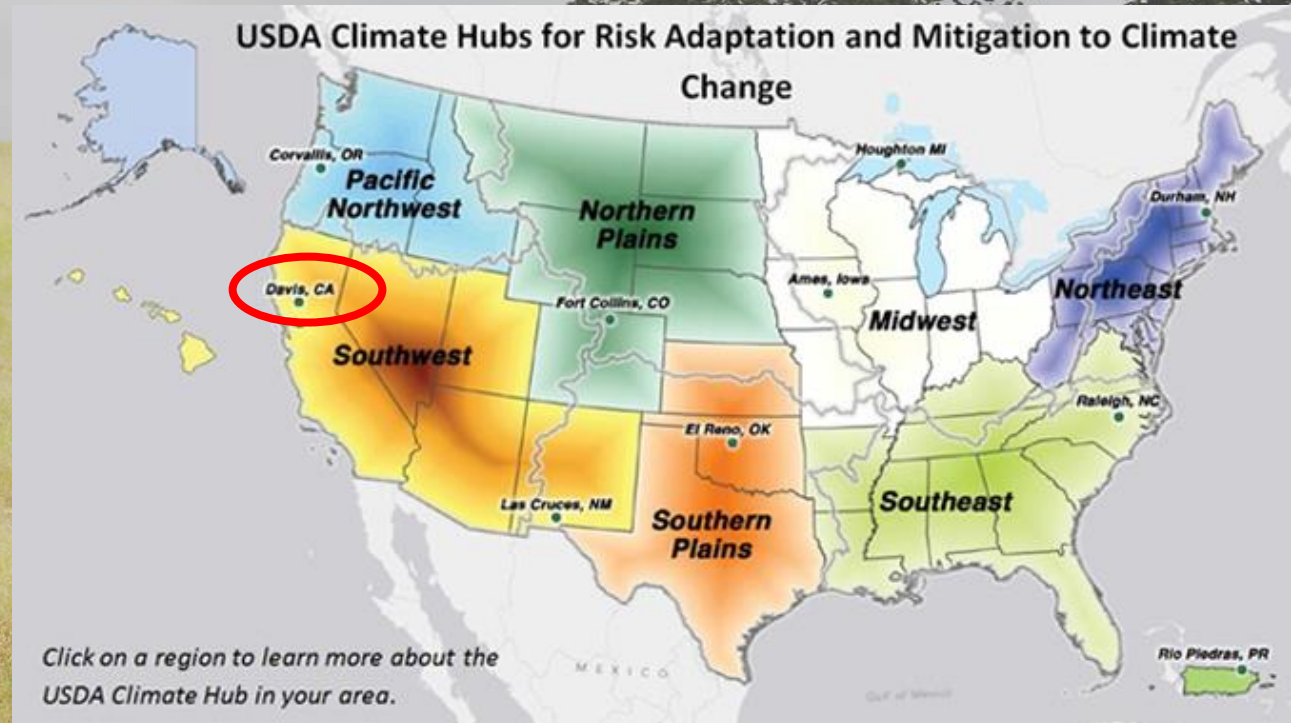
USDA California Climate Hub

Actionable Climate Information for California's Farmers, Ranchers, and Foresters



Steven Ostoja, PhD, Director

Jennifer Balachowski, PhD, Climate Hub Fellow



The challenge and approach

Research

Climatic Change
DOI 10.1007/s10584-007-9367-8

Accumulated winter chill is decreasing in the fruit
growing regions of California

Dennis Baldocchi · Simon Wong

Received: 2 August 2006 / Accepted: 5 October 2007
© Springer Science + Business Media B.V. 2007

Abstract We examined trees of central California and its warming is in motion in Ca across the fruit and nut grow accumulated winter chill (by climate datasets. The Calif contains hourly climate data chill degree-hours. But, its National Weather Service C many sites. But its datasets temperatures. To assess long algorithm that converted into accumulated hours of winter calculations of chill hour measurements from hourly-climate datasets, we found 1 degree hours is diminishing. Observed trends in winter chill applied our analytical algorithm projections of temperature for winter chill, for the period 1950 to 2099. By the end of the 21st century 500 chill hours per winter. This have deleterious economic at the end of the 21st Century.

D. Baldocchi (✉) · S. Wong
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University of California, Berkeley
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Climatic Change (2011) 109 (Suppl 1):S317–S333
DOI 10.1007/s10584-011-0303-6

California perennial crops in a changing climate

David B. Lobell · Christopher B. Field

Received: 9 March 2010 / Accepted: 26 September 2011 / Published online: 24 November 2011
© Springer Science+Business Media B.V. 2011

Abstract Perennial crops are among the most valuable of California's diverse agricultural products. They are also potentially the most influenced by information on future climate, since individual plants are commonly grown for more than 30 years. This study evaluated the impacts of future climate changes on the 20 most valuable perennial crops in California, using a combination of statistical crop models and downscaled climate model projections. County records on crop harvests and weather from 1980 to 2005 were used to evaluate the influence of weather on yields, with a series of cross-validation and sensitivity tests used to evaluate the robustness of perceived effects. In the end, only four models appear to have a clear weather response based on historical data, with another four presenting significant but less robust relationships. Projecting impacts of climate trends to 2050 using historical relationships reveals that cherries are the only crop unambiguously threatened by warming, with no crops clearly benefiting from warming. Another robust result is that almond yields will be harmed by winter warming, although this effect may be counteracted by beneficial warming in spring and summer. Overall, the study has advanced understanding of climate impacts on California agriculture and has highlighted the importance of measuring and tracking uncertainties due to the difficulty of uncovering crop-climate relationships.

1 Introduction

Agriculture is an important component of California's economy, landscape, and culture, and is among the human activities most vulnerable to impending climate changes. Two particularly unique and relevant features of agriculture in California are (1) the diversity of crops grown, with California the leading U.S. producer of over 80 crops, and (2) the substantial fraction of agricultural value (roughly one-third

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OPEN ACCESS freely available online

PLOS one

Climatic Changes Lead to Declining Winter Chill for Fruit and Nut Trees in California during 1950–2099

Eike Luedeling^{1,2*}, Minghui Zhang^{1*}, Evan H. Givetti²

¹ Department of Land Air and Water Sciences, University of California, Davis, California, United States of America, ² Department of Plant Sciences, University of California, Davis, Davis, California, United States of America, ³ College of Forest Sciences, University of Washington, Seattle, Washington, United States of America

is of a location's suitability for the production of many tree species future changes in winter chill in California, quantified models.

temperature records, winter chill was modeled for two past time (average conditions during 2041–2060 and 2080–2099) future scenarios, for the CGCM2.3.2a, INMCM2.3.2a, and BCCR2.2.2a. Temperature records were produced, using a stochastic climate model, “safe winter chill”, the 10% quantile of the amount of chilling that grown can safely expect under the scenarios, with the area of safe winter chill for many tree and 90–100% by late century.

Projected climate conditions by the middle to end of the 21st century grown in California, with the Climate Change Model free crop industry in California will likely need to develop dormancy-breaking chemicals to cope with these projected trends.

Using Winter Chill for Fruit and Nut Trees in California during 1950–2099, PLOS one

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doi:10.1371/journal.pone.0021000

Straw flowering, such as wheat and rice, is sensitive to chilling. Chilling can reduce pollination, also leading to reduced crop yields [10]. If winter chill declines across due to climate change, production constraints are likely to exceed those typically reported, because many trees might not even come close to fulfilling their chilling requirements. In such cases, complete crop failure may frequently occur, while early onset of winter will further reduce their yield potential, resulting in many orchard operations non-viable [4,11].

Agricultural scientists have developed mathematical models that are used by growers to select crop cultivars with chilling requirements that correspond to available chilling at a specific location. However, a greater understanding of available winter chill is likely to reflect conditions of the past rather than those expected for a warmer future. Since orchard sites remain in production for decades, consideration of future expected winter chill is necessary in cases of increasing climate change. Without such consideration, many orchards might involve inadequate chilling by the time they reach physiological maturity, even though at the time of planting, climate conditions were optimal for the chosen cultivars. Depending on the pace of winter chill decline, the

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Bridging Mission
of the USDA
Climate Hubs



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Thank you – Contact The USDA Regional Climate Hub

Steven Ostoja, PhD

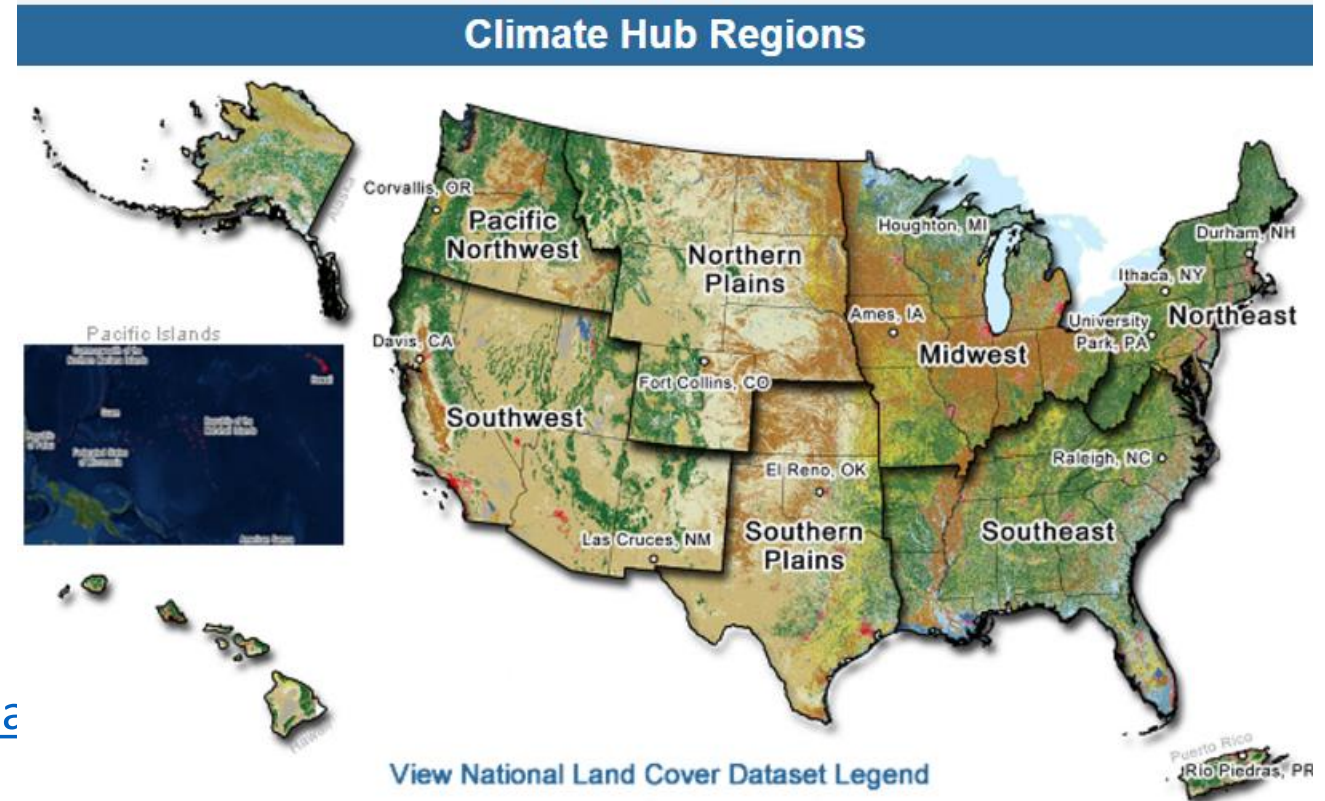
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United States Department of Agriculture
California Climate Hub

WATER DURING HISTORIC DROUGHTS

- Richard McLoughlin,
Assistant Secretary
Water Resources, Water Division,
Department of Agriculture and Water
Resources



- Kamyar Guivetchi, PE
Statewide Integrated Water Management
California Department of Water Resources





Australian Government
Department of Agriculture
and Water Resources

Climate Smart Agriculture: Irrigation water management

California – Australia
Webinar
20 June 2017

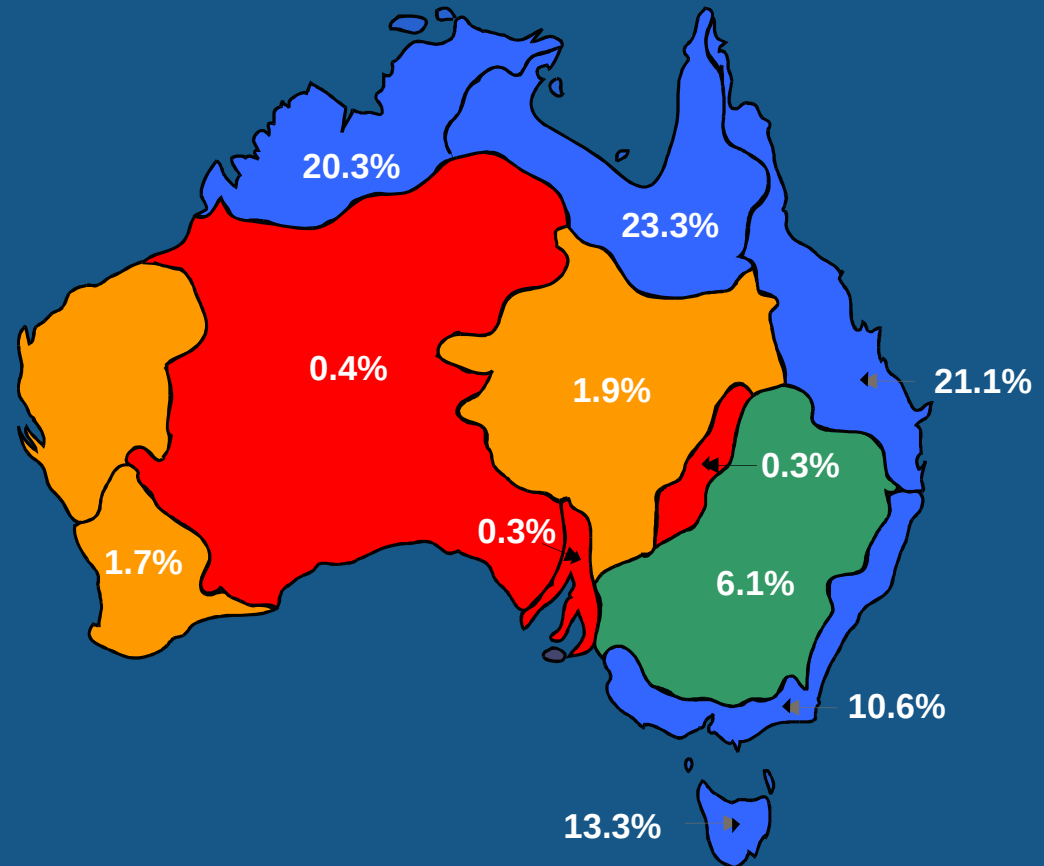
Richard McLoughlin
Department of Agriculture and Water Resources



Distribution of Australia's Rainfall Runoff

Challenges

- Extremes of weather
- Population growth
- Climate change threats
- Declining ecological health of waterways and wetlands
- Water scarcity
- Economic dependence of rural towns
- Disconnect between water and location of people



Water Management in Australia

Key concepts

- Water is publicly owned until it is legally allocated to a water access licence holder.
- Water is mainly a State responsibility
- Trans-boundary issues (e.g. Murray-Darling, Great Artesian, Lake Eyre Basins) managed via intergovernmental agreements (Not legally binding)
- Water operations are regulated by the states/territories through water access licences , which are a tradable asset
- Prices are set by the market – normal supply/demand drivers
- Same rules apply for all traders/users – governments, private irrigators, investors or industry

Policy Driven Water Management

Principles

National Water Initiative is the agreed national policy framework for how water resources should be managed and shared to support communities, the environment and economic development. NWI principles also underpin the regulatory framework and the operation of water markets.

Legislation & Regulation

Commonwealth Legislation

- Water Act 2007
- WELS Act
- Water charge and market rules
- Water information
- Commonwealth Environmental Water Holder
- Lake Eyre Basin Intergovernmental Agreement Act 2001

State Legislation/regulation

- State Water Acts
- Water resource planning
- Operations of state water authorities

Murray
Darling Basin
Agreement

Implementation

Australian Government

- MDB Sustainable diversion limit
- Water recovery strategy
- Water markets
- Strategies, framework and guidelines for water quality management, urban water and groundwater management.

States

- Water resource plans
- Urban water management
- Groundwater management
- Water quality management

Programmes

Commonwealth & States

- Irrigation efficiency projects
- Environmental measure projects
- Urban water programs

States

- Infrastructure projects

National Water Initiative - the blueprint for water reform

- Important NWI principles:
 - Economic and efficient use of water
 - Surface and groundwater mostly treated the same
 - Market based mechanisms to allocate new water
 - User-pays for water management
 - Efficient functioning of water markets
- The NWI provides greater certainty and confidence for investors, particularly the unbundling of water entitlements from land
- Water for the environment explicitly included
- Commonwealth water infrastructure investments are conditional upon the implementation of NWI arrangements.
- The NWI principles provide investment security for the Commonwealth, state and territory governments and water users.



Murray-Darling Basin

- Supports two thirds of Australia's irrigated agriculture
- Agriculture in the basin contributes \$15billion to the national economy annually
- Supports significant biodiversity values
- Sustains 16 Ramsar listed wetland sites

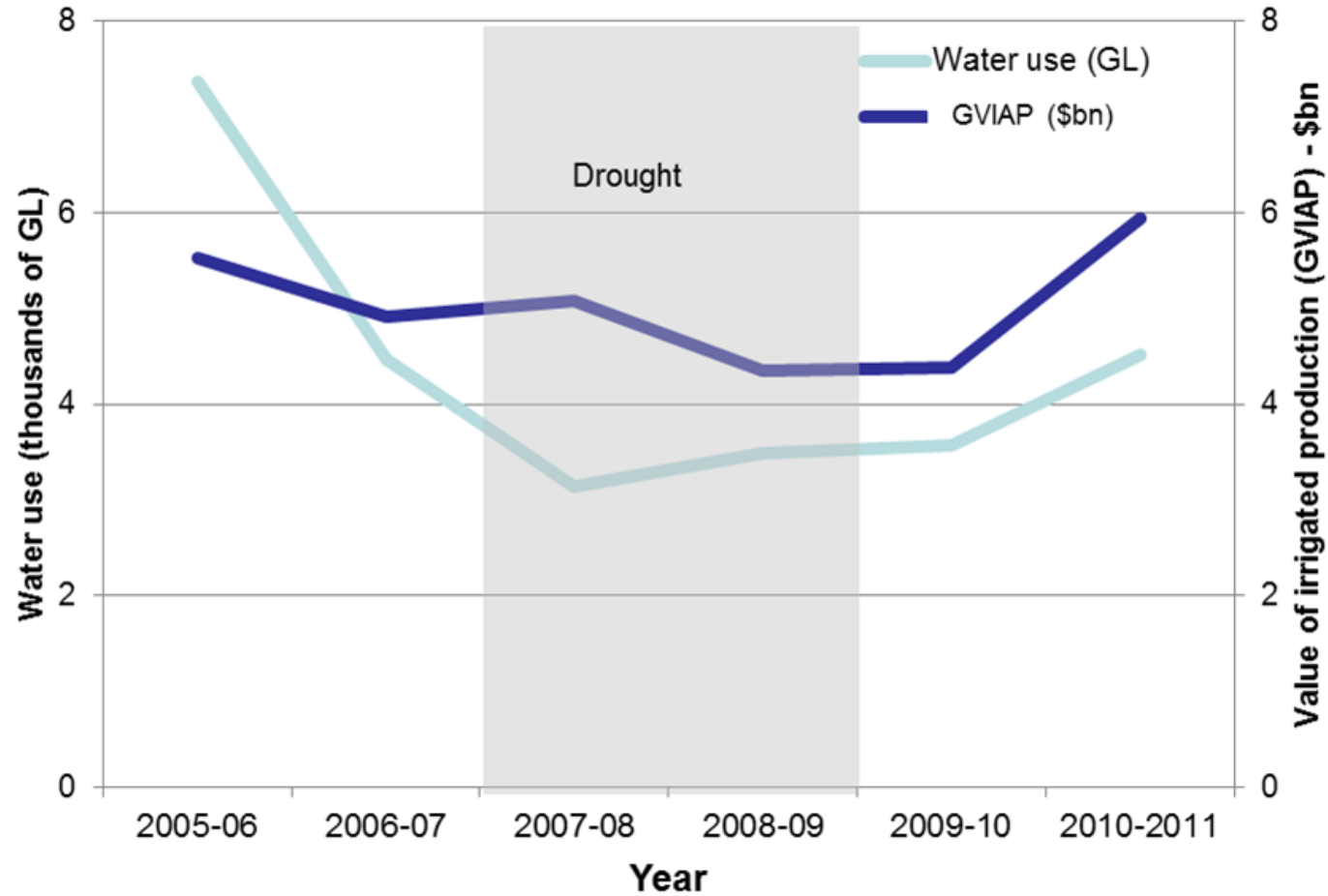


Whole of Basin Planning

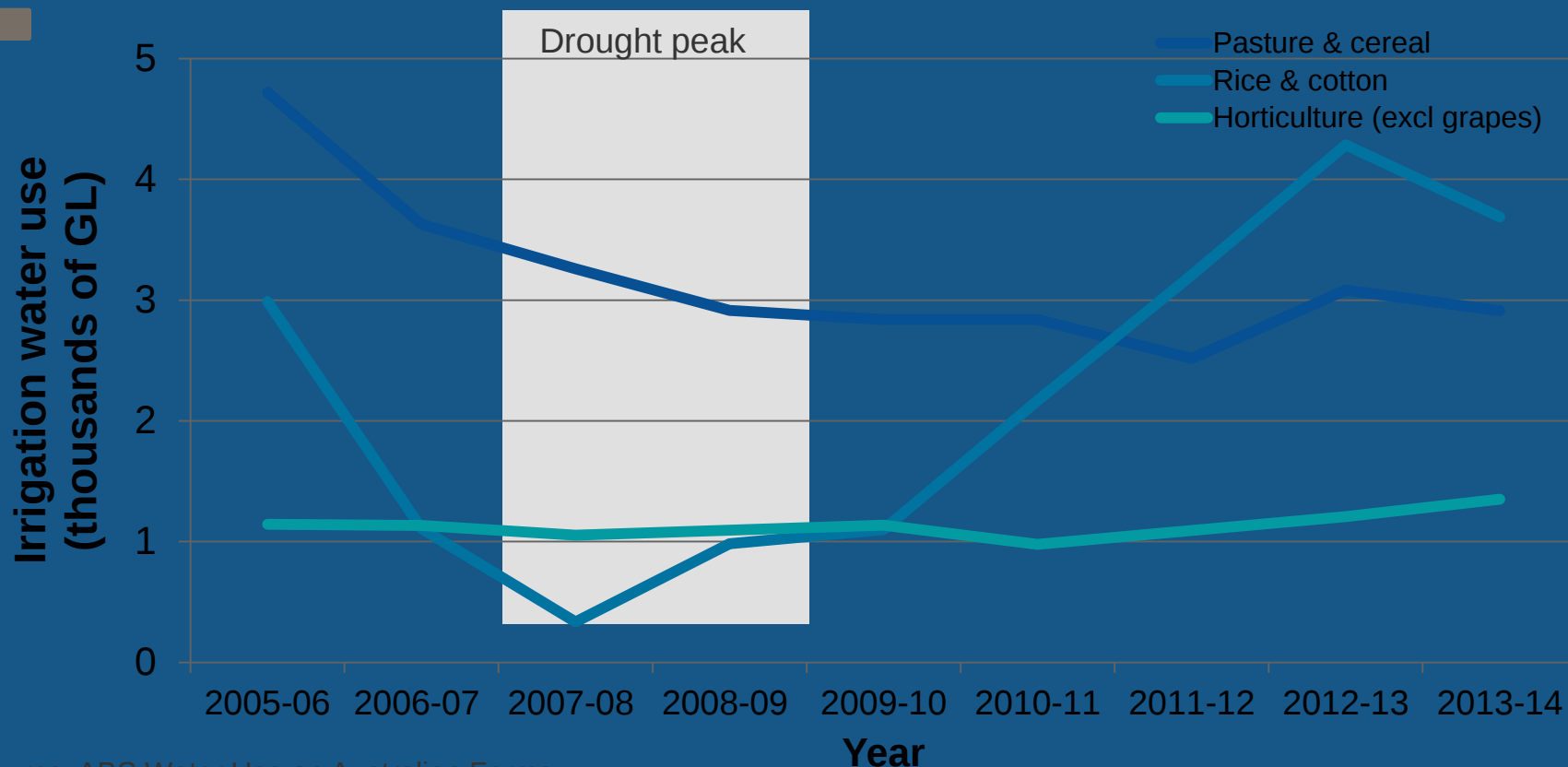
Murray-Darling Basin Agreement

- Sustainable Diversion (extraction) Limits - surface and groundwater
- Basin-wide environmental objectives
- Consistent basin-wide water trading rules
- State-based water resource plans and accreditation
- Environmental watering plan and management of environmental water
- Water Quality & Salinity Management Plan
- Monitoring and Evaluation program

Murray Darling Basin Water use and GVIAP



During the drought, irrigation water use by horticulture stayed relatively unchanged while water used by annual crops fell dramatically



Source: ABS Water Use on Australian Farms

Water Markets

- Separation/decoupling of water from land property rights crucial for development of water markets
- Water operations are regulated by the states/territories through water access licenses , which are a tradable asset
- Water markets play a critical role in allowing water to its highest value use, including for urban use
- The market price of water – determined by water users rather than government - informs decision making about water use and trade
- The Australian Government uses water markets to purchase and direct water for environment use.
 - Same rules apply to government as any other water user in the market

What Enables Water Markets to Work Well ?

- Good information flows
- Legal security over entitlements
- Minimisation of legal barriers/distortions
- Minimisation of transaction costs
- Consistent and timely transactions
- Adequate volumes to trade
- Trust that participants, including government agencies, will honour their obligations



Australian Government
Department of Agriculture
and Water Resources

Thank You

Richard McLoughlin
Assistant Secretary
Water Resources Branch
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Water Division

June 2017



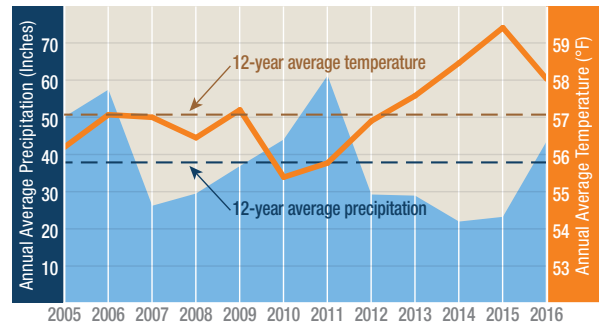
California's Emergency Drought Declaration Is Lifted

State advances measures to make conservation a way of life

California Under Drought

Climate change means increasingly extreme and unpredictable weather. We have seen record-high temperatures and record-low precipitation during this historic five-year drought.

Frequent, large storms this fall and winter eased drought conditions across California. Most major reservoirs have recovered, and an above-average snowpack will feed lakes well into summer. For the most part, the severely dry conditions that afflicted much of the state since 2012 are gone.



California has experienced near-record temperatures in recent years.

Source: California Department of Water Resources

Learning from the Drought

California faces challenges from climate change and a growing population. We have learned from the drought and incorporated these lessons into the state's Water Action Plan, a five-year roadmap for sustainable water management.

A few components of the Plan:



Conservation as a way of life: Reducing statewide water usage is necessary to ensure the resilience of our water supplies for increasingly severe and frequent droughts. That's why the state bolstered the Save Our Water campaign, offered rebates to retrofit tens of thousands of inefficient toilets, replaced 50 million square feet of turf with drought-tolerant landscapes, required agricultural water management plans and more.



Sustainable Groundwater Management Act (SGMA): During times of drought, many communities depend on groundwater supplies. But over reliance has led to a rapid depletion of this critical water source. Groundwater aquifers need to be replenished. SGMA provides a regulatory framework for sustainable, local groundwater management for the first time in California history.



Improve Drinking Water: Millions of Californians, especially those in disadvantaged communities, rely in part on unsafe drinking water. California has improved the organization of our water quality programs and created new tools to ensure every Californian has access to clean, safe, and affordable water.



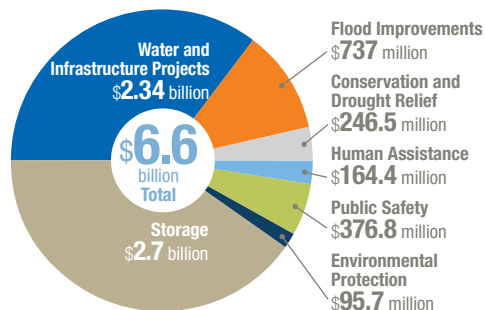
Restoring Important Ecosystems: Prolonged drought also affects the state's fish and wildlife, exposing and exacerbating population vulnerabilities. The state invested tens of millions of dollars in habitat restoration projects designed to address immediate drought concerns and increase resiliency to climate change.



Real-time Management of Water Project Operations: Especially in drought conditions, real-time management can have substantial fishery, water quality, and water supply benefits. To improve water supply reliability and consequently improve drought preparedness, the state increased the flexibility of its water infrastructure to ensure adequate levels in reservoirs, manage water temperatures for fish upstream, develop salinity barriers to protect fresh water and more.

Investing in Drought Solutions

The state has deployed numerous resources—fiscal, logistical, and personnel—in responding to the impacts of the drought. This includes Proposition 1, which was passed by a 67% majority of California voters in 2014. It authorized \$7.5 billion in general obligation bonds to fund ecosystem and watershed protection and restoration, and water supply infrastructure projects, including surface and groundwater storage and drinking water protection.



Since 2014, the state has appropriated \$6.6 billion for drought response.

While the emergency drought declaration has been lifted, the state should maintain directives that promote a sustainable water future and prohibit wasteful practices.

Milestones of the Drought

2014

January

- Governor declares State of Emergency due to drought.
- State Water Resources Control Board (SWRCB) temporarily modifies flow and water quality requirements for state and federal water project operations in the Delta.



April

- Governor issues Executive Order to extend State of Emergency, expedite drought response activities and implement water conservation requirements.
- SWRCB and the Governor's Office of Emergency Services begins allocation of more than \$32 million for drought-related emergency projects including drinking water.

May

- Through 2016, SWRCB adopts and renews emergency regulations to help protect threatened and endangered fish species in high priority watersheds.

June

- SWRCB adopts general order expanding authorized uses of recycled water.

July

- SWRCB institutes new temporary restrictions on outdoor water use and new water use reporting requirements for urban water suppliers.



September

- Legislature passes package of bills implementing the Sustainable Groundwater Management Act.
- Governor issues Executive Order to address drinking water shortages.

November

- California voters pass \$7.5 billion water bond, the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1).



Governor Brown has signed...

7 Gubernatorial Actions

— and —
24 drought bills

These actions address immediate health, safety and ecosystem needs while also accelerating improvements to water infrastructure and habitat that will have a permanent effect on our ability to withstand drought.

2015

April

- DWR conducts annual snow survey, confirms statewide snowpack contains less water content than any comparable survey measurement since 1950.
- Governor issues Executive Order imposing 25 percent statewide urban water reduction and initiating state-funded turf removal and water-efficient appliance programs.

May

- DWR installs temporary rock barrier at West False River to keep tidal salt water from flowing too far into the Delta.

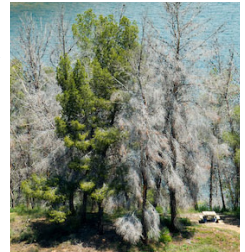


July.....

- New Water Efficient Landscape Ordinance permanently increases water efficiency standards for new and retrofitted landscapes.

October.....

- Governor declares State of Emergency for epidemic of drought-related tree die-off.



2016

January

- SWRCB adopts emergency regulations for measuring and reporting water diversions.

February

- SWRCB expands low financing program for recycled water projects.

April

- Since 2013, Californians save 1.19 million acre-feet of water, enough to supply nearly 6 million people for a year.

May

- Statewide average water conservation rate grows to 28 percent.

June

- DWR and SWRCB connect East Porterville to the City of Porterville's water system, bringing a reliable water supply to nearly 1,800 homes that lacked safe water.

August

- Shasta, the state's largest reservoir, reaches 110% of historical average.

2017

January

- Statewide water savings surpass 20 percent.

February

- Statewide snow water equivalent is 30.5 inches, 174% of average for that date.
- SWRCB extends existing water conservation regulations.

April

- Governor Brown lifts drought emergency declaration, retains prohibition on wasteful practices, and advances measures to make conservation a way of life.

WATER EFFICIENCY AT THE DISTRIBUTION LEVEL

- John Culleton
Coleambally Irrigation
Co-operative Limited



- Peter Rietkerk
South San Joaquin Irrigation
District





**Climate Smart Agriculture Webinar
Coleambally Irrigation Co-
operative's Perspective**

20 June 2017

Key Tenets

- Climate smart agriculture involves more than the efficient use of resources
- Government should encourage climate smart agriculture but
 - should avoid trying to pick ‘winners’
 - and not try to bring about change without first understanding what it is it is changing
- Climate smart agriculture requires enduring commitment to RD&E and to environmental stewardship



Operational Setting

- Cropping all year round but 80% of income generated by summer cropping
- Highly variable rainfall & regulated river operations
- Allocation system based on dam storage levels & type of water entitlement held
- Most CICL farmers hold General Security water entitlement - long-term reliability is approximately 70%
- When allocations are low, many farmers will trade their water

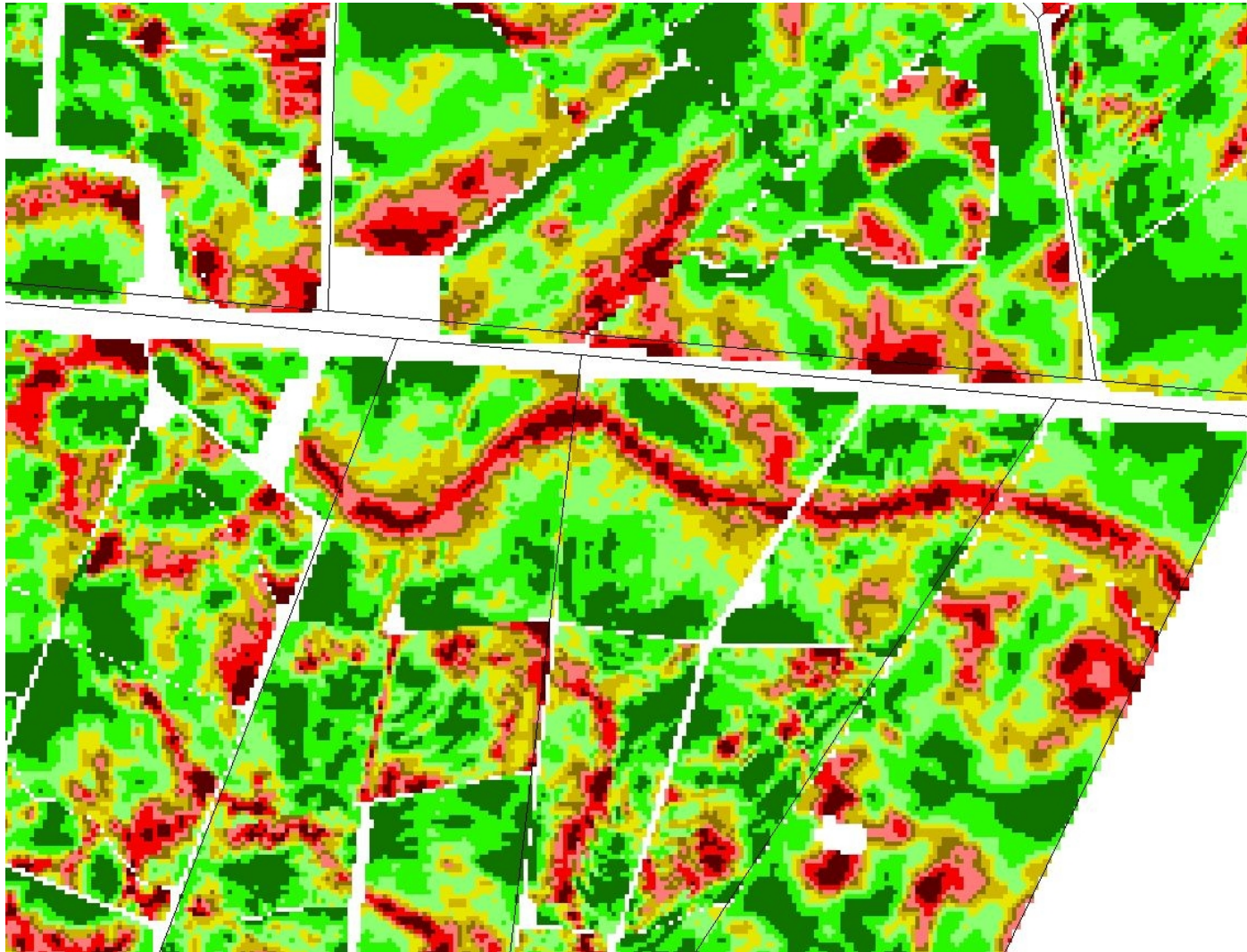
Operational Numbers

- Fully automated gravity-fed & solar powered distribution delivering water over an operating area of 450,000 ha (1,111,974 acres)
- 518 km of Supply Channels & 734 km of Drains; servicing 479 farms
- 512 GL (415,085 acre feet) of surface water on CICL's licence
- Average size of irrigated properties is 200ha (494 acres) but dryland farms are much bigger

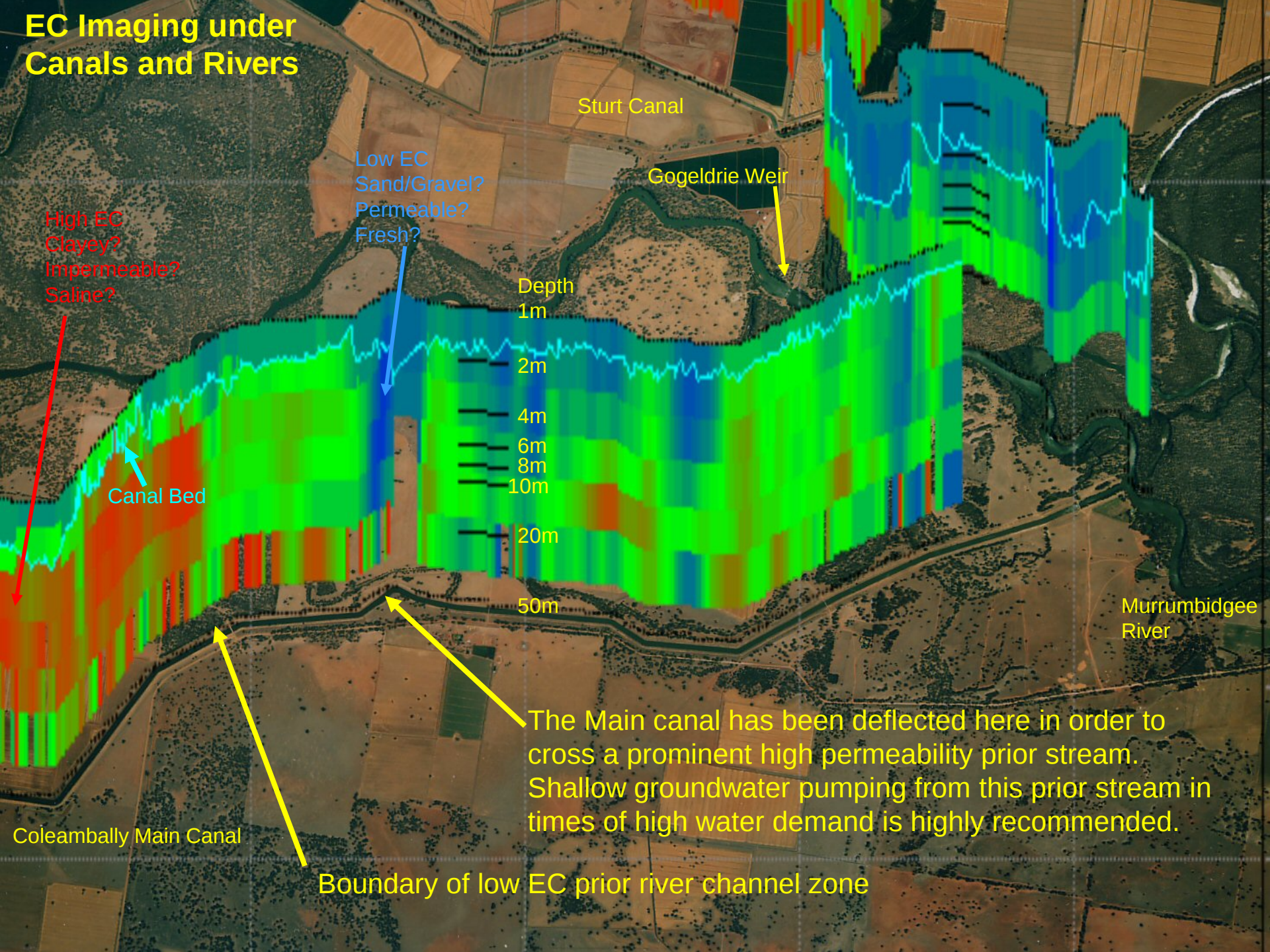
Modernisation Journey

- Journey commenced in 1999 with an on-farm focus
 - 15 year Land & Water Management Plan (water table 'driver')
 - Whole-farm plans
 - Recycling
 - Habit protection
 - Water use intensity trigger
- Delivery system modernisation
 - Understanding & remediating water losses
 - Better understanding of local weather conditions
 - Automation of water demand, accounting & distribution & , accurate metering
 - Sale of water entitlement to Government @ above market rates

EM31 – Prior Streams



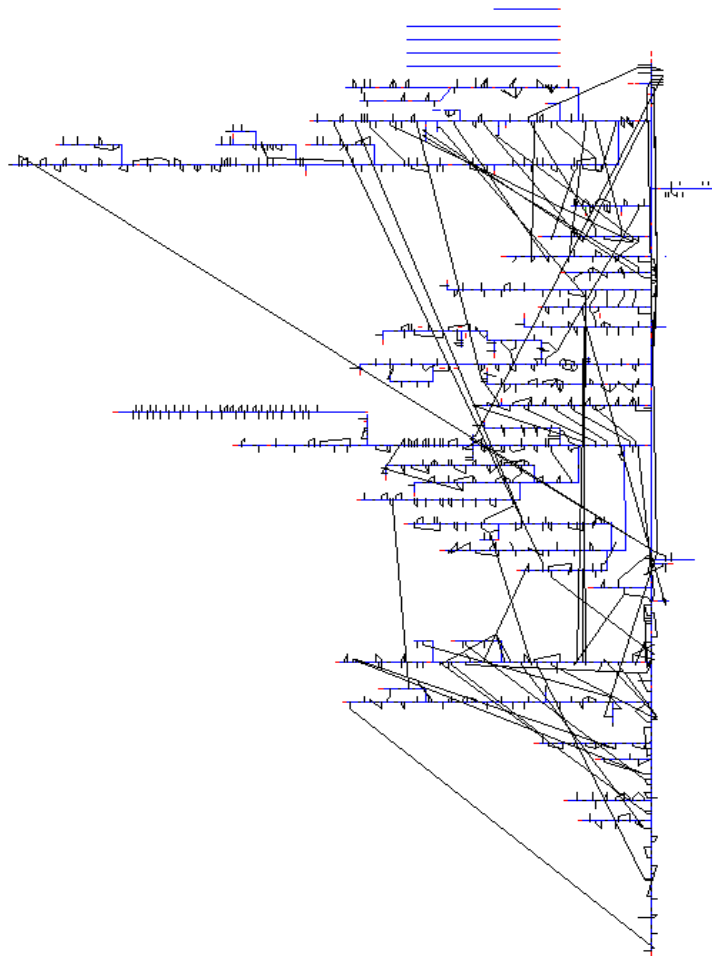
EC Imaging under Canals and Rivers











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Overview



Comms.



Back



Forward



Alarms



Trend



Paging



Log In/Out



Exit

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Time

Poll



SITE ID 2018

RTU Software Ver. No. 3.900

- Control Suspended
- Peer Communications Status
- RTU Time Not Set
- Sites Table Not in MOSCAD RTU

Control Mode POSITION

U/S Water Level 1.179 m

0.000

D/S Water Level 0.462 m

0.0

Current Flow 0.0 ML/d

Current Volume for Season 10523.4 ML

Site Status

Sensor Status

Local Ctrl. Tuning

TCC Tuning

Comms. Setup

Presets

Flow Accum.

Flow Calc.

Flumegate R

GATE 1

SDB 5.140

Gate 1 Position 351 mm

350

Gate 1 Elevation 1.217 m

Gate 1 Flow 0.0 ML/d

e 1 in Manual Mode

NO

Gate Status

Remote Mode

GATE 2

SDB 5.140

Gate 2 Position 351 mm

350

Gate 2 Elevation 1.217 m

Gate 2 Flow 0.0 ML/d

e 2 in Manual Mode

NO

Gate Status

Remote Mode

GATE 3

SDB 5.140

Gate 3 Position 351 mm

350

Gate 3 Elevation 1.217 m

Gate 3 Flow 0.0 ML/d

e 3 in Manual Mode

NO

Gate Status

Remote Mode

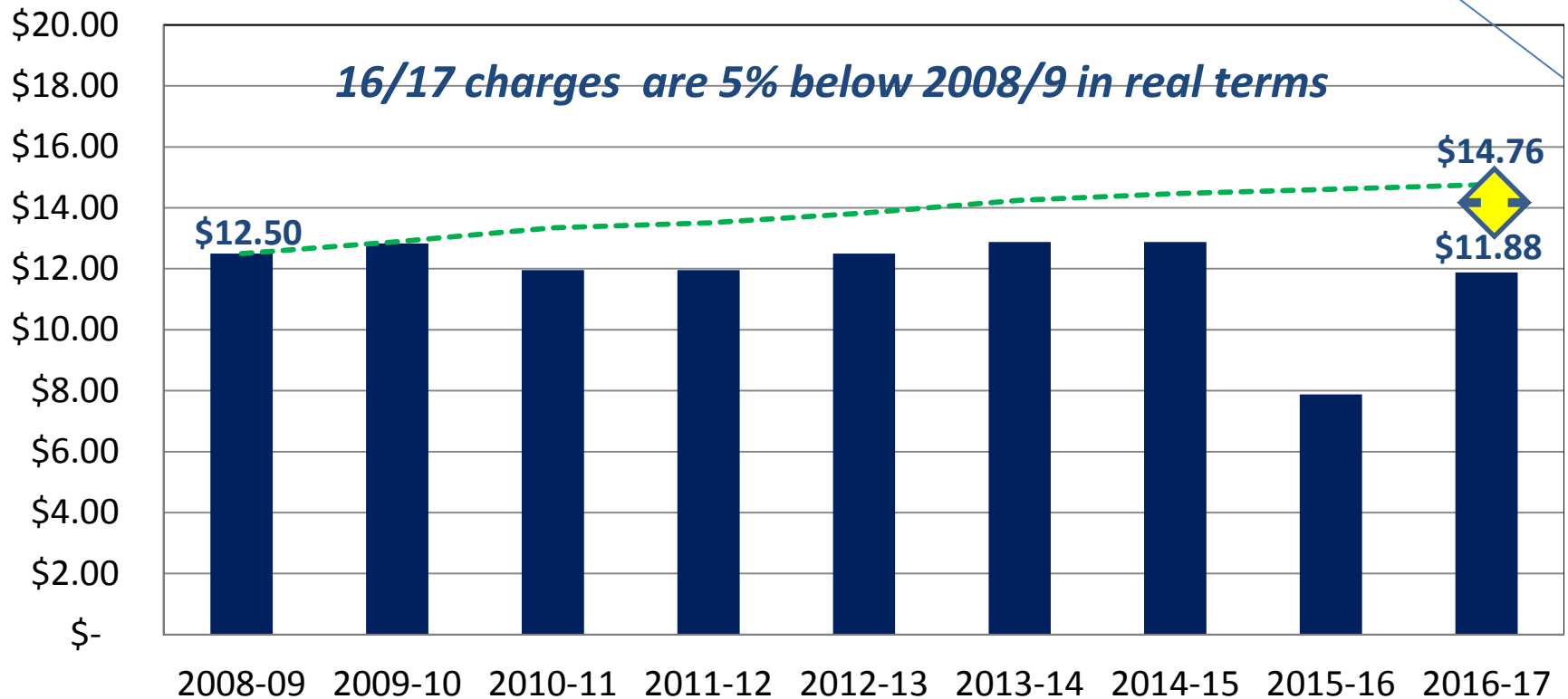
Modernisation Outcomes

- Water savings of approx 65,000 ML (53,000 acre feet) per annum
- Fewer, but better paid, employees
- Most efficient open-channel operation in Australia
 - Automation down to farm gate
 - Shortest water ordering time (2 hours)
 - Guaranteed minimum level of supply (14ML/day or 11.35 acre feet/day)
 - Lowest system losses
 - High peak flow rates
 - Quality of drainage
 - Most stable pricing & best return to owners

Modernisation Outcomes – Increased Operating Efficiency (Losses in ML)

99/00	75,800 (61,398)	08/09	32,046 (25,957)
00/01	85,806 (69,502)	09/10	39,839 (32,269)
01/02	99,690 (80,749)	10/11	32,316 (26,175)
02/03	110,312 (89,352)	11/12	33,081 (26,795)
03/04	90,123 (72,999)	12/13	28,813 (23,338)
04/05	108,026 (87,501)	13/14	25,056 (20,295)
05/06	39,784 (32,225)	14/15	26,975 (21,829)
06/07	35,704 (28,920)	15/16	27,084 (21,938)
07/08	30,627 (24,807)		

Modernisation Outcomes - Price Stabilisation



A Unique Business Model

- Fixed charges
- Charges based on Delivery Entitlement not Water Entitlement
- Price stabilisation – a strategic objective
- Water Savings shared with Members (60% @ no cost, 40% @ below market price, both pro-rated against amount of delivery Entitlement held)

Environmental Management

- **Environmental management is Core Business**
- Bound by Operating and Environmental licences
- Explicit reference to environmental requirements in CICL Rules
- ‘Centre piece’ is CICL’s Water Use Limit Policy to control water table/salinity & CICL’s Drainage Policy to control water quality quality
- 800 piezometers read twice a year
- ALL ‘take’ accurately metered
- Policies are ‘real’ and enforced

Climate Smart Agriculture (cont)

- Nothing that CILCL has done since privatisation has been solely about Climate Smart Ag – rather a case of realising that it need to adapt to a changing world (government/market forces/technology/rising input costs/societal expectations & climate)
- Required a multi-faceted approach, which included
 - privatisation
 - modernisation
 - new business model
 - repositioning environment, compliance & government relations to be core business

Climate Smart Agriculture (cont)

In Members' case:

- a commitment to more sustainable farming & modernisation
- Increased emphasis on all year-round cropping & crop diversification
- increased scale of operations & new business structures
- acceptance of water trading
- viewing Water Entitlement differently
- increased acceptance (albeit sometimes reluctant) of climate change & place of the environment

Climate Smart Agriculture (cont)

- Government' place:
 - Improved regulation, not more regulation
 - Creation of the right conditions for change
 - Reduced uncertainty
 - Targeted /strategic intervention:
 - Provision of 'enablers' (tax, incentives, timelines etc)
 - Continued support for Research, Development & Extension
 - Resisting the temptation to pick 'winners'

Climate Smart Agriculture (cont)

- Industry's place
 - Needs to be Involved in the design of related Government policy, programs & incentives
 - Needs to be seen as a 'delivery partner' (upwards & downwards)
 - Needs to co-invest, be open to new business models
 - Needs to understand that it operates with a social licence & see environmental management as core business
- Irrigators' place
 - Can't afford to stand still
 - Also need to understand that they operate with a social licence & see environmental management as core business
 - Need to understand that producing food in sustainable & responsible ways makes good business sense

Climate Smart Agriculture – a “Marriage”

- Good policy settings
- Properly functioning markets
- Good climate/weather research & forecasting
- Government & Industry commitment to Research, Development & Extension
- Industry leadership, to encourage & facilitate on-farm adaptation
- Enduring commitment by Government, industry & farmers to sustainable production & environmental stewardship

Meeting Changing Irrigation Demand through Pressurized Distribution

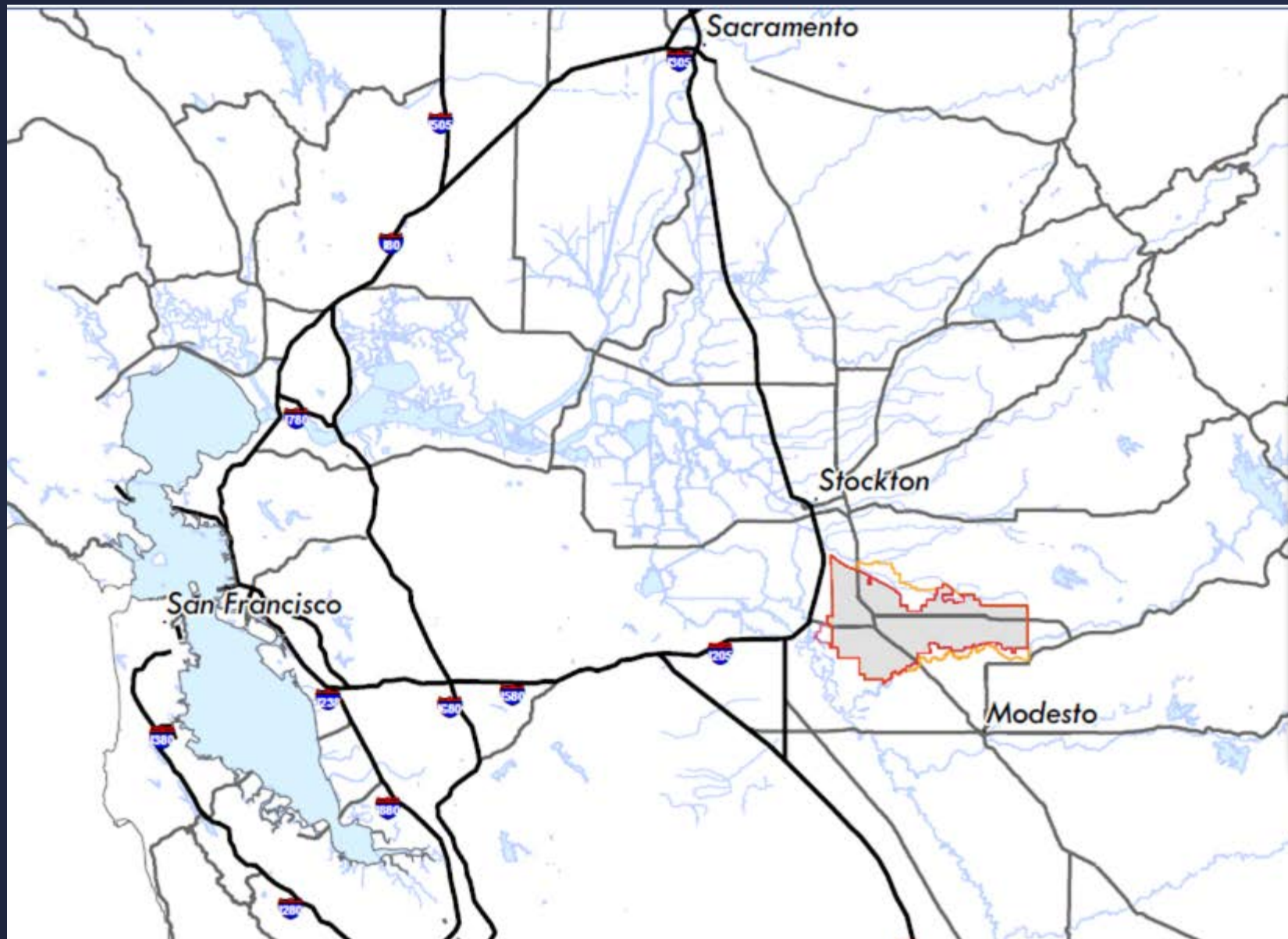


SOUTH SAN JOAQUIN
IRRIGATION DISTRICT

Peter Rietkerk, M.S., P.E.
General Manager, South San Joaquin Irrigation District
Climate Smart Agriculture: Irrigation Water Management and
Technologies Webinar
June 19, 2017

About South San Joaquin Irrigation District...

- Irrigation District formed in 1909 and has senior water rights on the Stanislaus River
- Delivery system was designed to deliver water by gravity flow from dams and reservoirs on the Stanislaus River through a network of canals and pipelines to its 72,000 acre service territory.
- 13 miles of supply canal, 18 miles of main distribution canal, 312 miles of distribution pipelines, 38 miles of lined lateral canals, one off-stream reservoir
- Serve approximately 56,000 acres of irrigated agriculture consisting of
 - Permanent Crops (75%)
 - Almonds (64%)
 - Walnuts, stone fruit, and wine grapes (11%)
 - Annual crops (21%)
- Operate a Water Treatment Plant for wholesale deliveries to local cities



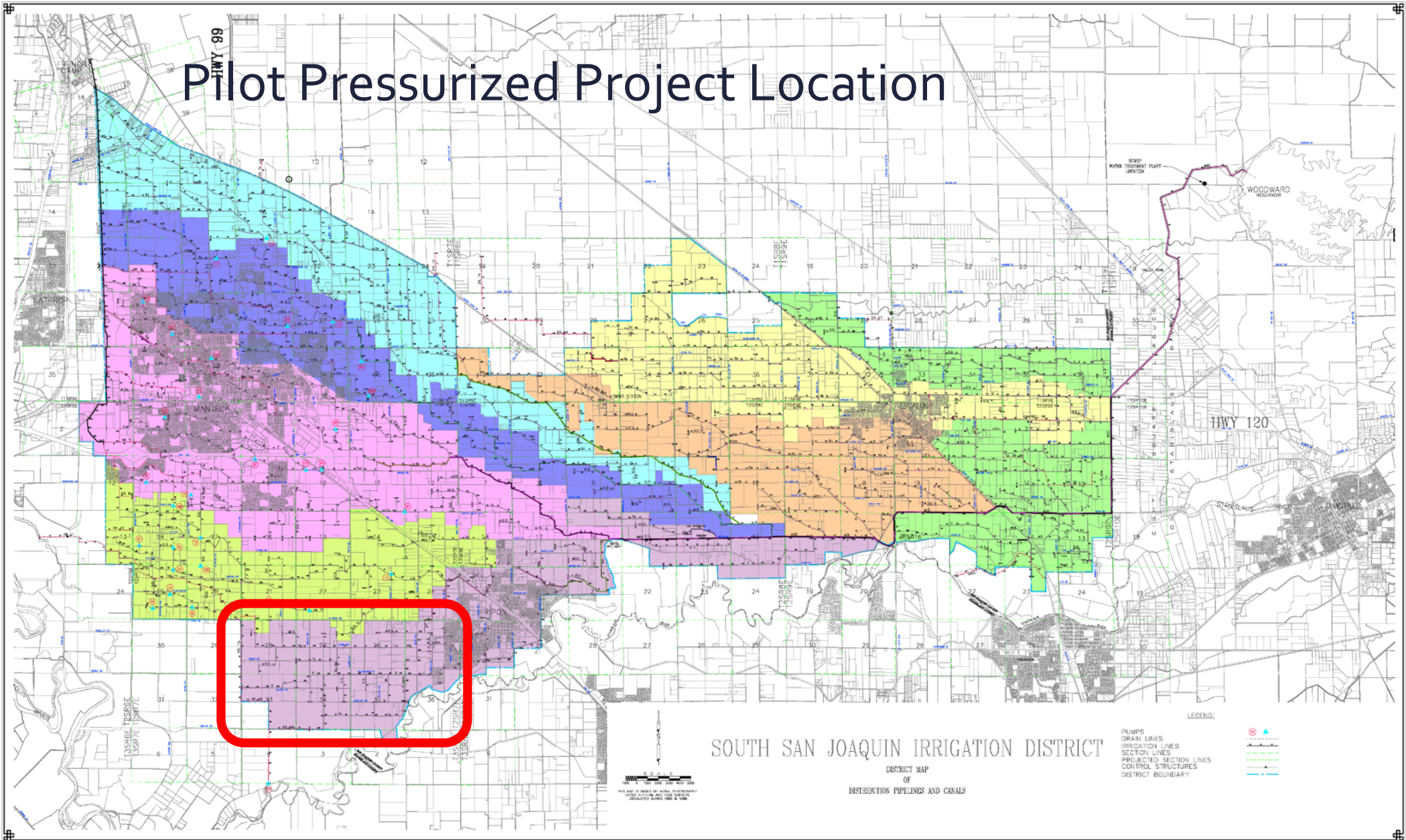
Water Costs and Drought

- For irrigation delivery, gravity distribution reduces operating costs, meaning most irrigation water O&M costs are fixed, however the amount of water delivered during the drought decreased, thereby increasing irrigation cost-of-service.
 - 2012 \$72.48 / acre-foot
 - 2013 \$79.65 / acre-foot
 - 2015 \$90.00 / acre-foot (approx.)
- In 2015 and 2016, the District adopted allocation limits on growers to match available supplies and promote conservation of limited resource to preserve stored water
 - 2014 No allocation limit
 - 2015 36-inch vertical limit
 - 2016 40-inch vertical limit
 - In each year, equivalent reduction in treated water allocations to Cities

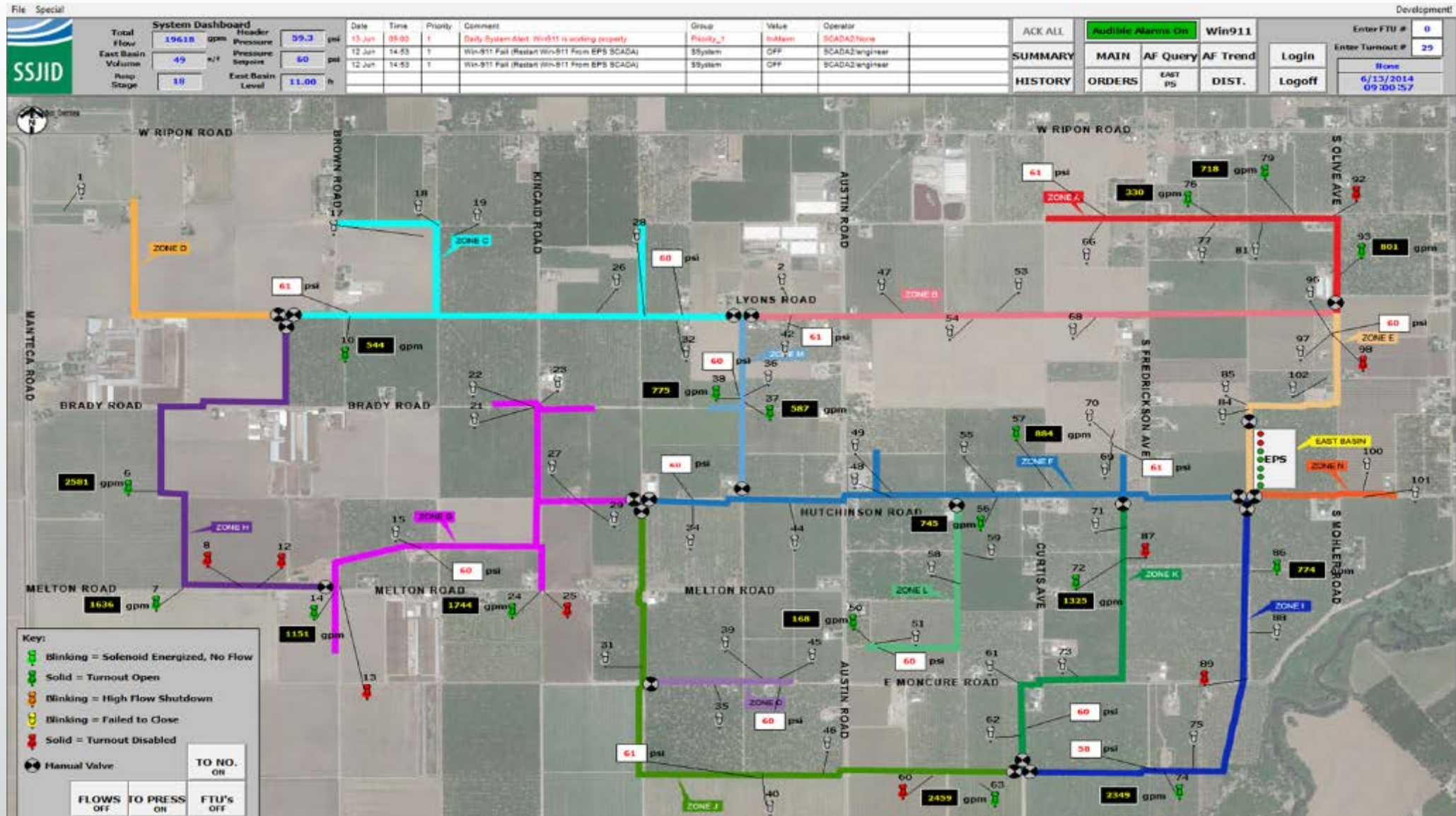
Background

- Water delivery is accomplished through a rotational schedule where growers are notified of availability of water every 10 days
- The system was designed for flood irrigation which resulted in operational spills and tail water drainage.
- Increasing number of growers who have decided to convert to more water efficient systems such as drip and sprinkler irrigation and want more flexibility in delivery schedules to optimize crop water management, reduce irrigation water use
- District decided to construct a “proof-of-concept” pilot pressurized irrigation project to improve irrigation delivery flexibility and conservation

Pilot Pressurized Project Location



Project Map- 3,800 acres (1,540 hectares)



East Basin Pump Station

- Vertical Turbine Pumps (VFDs)
 - 4-5,000 GPM
 - 1-2,500 GPM
 - 2-1,000 GPM (alternating)
 - 7 pumps total at 23,500 GPM or 52 CFS (1,225 total HP)
- Provides 55 PSI of pressure to each customer
- 58 acre-foot reservoir
- Control room with SCADA equipment and servers for automation and customer scheduling



Customer Turnouts

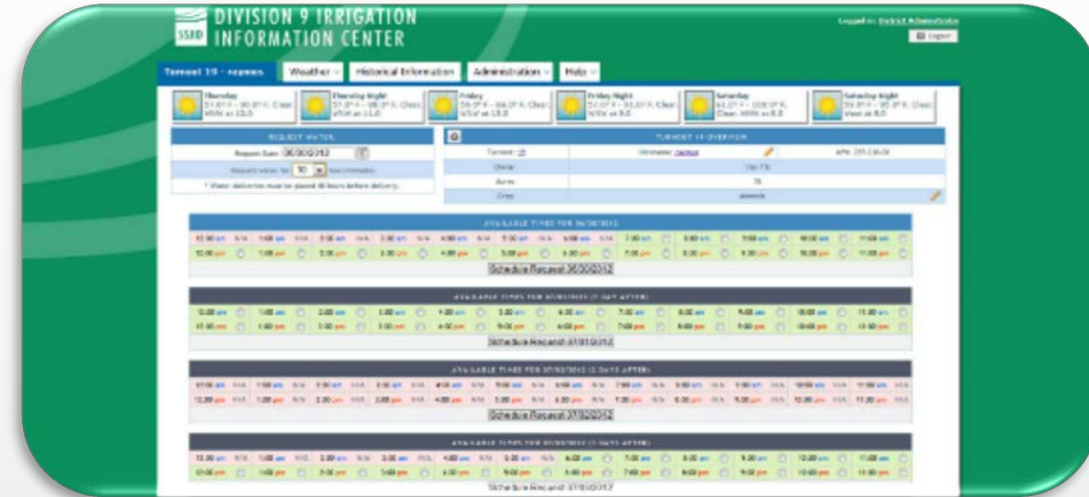


Field Telemetry Units



Innovative Features

- Web-based Customer Portal
- Weather and moisture sensor data to make irrigation scheduling decisions
- Airline-ticket style ordering
- Email and text notifications to confirm irrigation events
- Control algorithms to prevent water loss due to catastrophic failure



Key Benefits of Pressurized System

- Provided customer with a flexible irrigation schedule
- Reduced operational spills and efficient water usage resulted in 12,500 AF of water savings per year
- Reduced groundwater pumping through in-lieu recharge
- Improved yields (Pressure customers reported 6,900 lbs / acre for existing orchards and 180 lbs/acre on orchards with second leaf)
- Reduced farm runoff (flood irrigators were able to irrigate quicker)
- Reduced production inputs (better application of chemicals)
- Ability to accurately bill volumetrically (complies with SBX7-7 Magnetic flow meters at each customer connection accurate to 0.5%)
- Reduced overall energy use (eliminated inefficient farmer pumps)
- Improved air quality by eliminating diesel pumping
- Reduced on-farm labor and O&M costs

Construction & O&M Costs

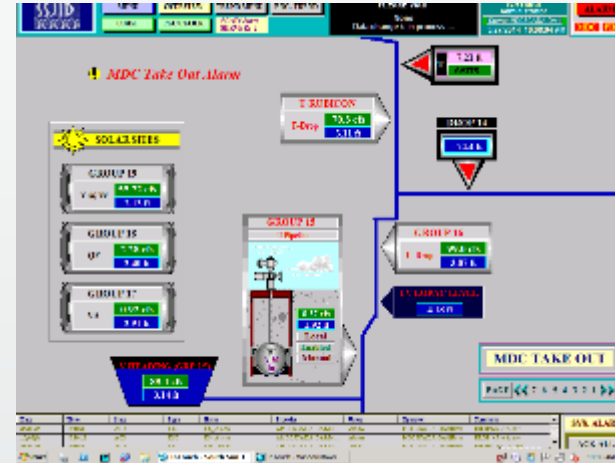
- Construction Costs: \$14,000,000 (US)
- Bureau of Reclamation Grant: \$1,000,000
- Net District Construction Cost: \$13,000,000
- Customer pays \$30 per ac. ft. in addition to the base charge (recently increased to \$44.00 per acre-foot)

Feasible at the District Scale?

- Completed a study in 2016 aimed to determine the feasibility of upscaling the pressurized irrigation concept to the District level
- Findings:
 - Financial Feasibility – Magnitude of capital costs would exceed customers ability or willingness to pay rates inclusive of capital and O&M costs unless outside funding was generated through water transfers or grant opportunities.
 - Economic Feasibility – on farm benefits did not exceed costs
- Customers love the service and wish to have it throughout the District, however economics preclude the ability of the District to construct the project without outside funding.

Other Conservation Efforts

- Main distribution canal flow measurement and automation
- On-Farm metering program
- Drain monitoring
- Conservation funding program
- Licensed microwave communication system
- Mobile deployment of SCADA and water accounting to distribution operators





SOUTH SAN JOAQUIN
IRRIGATION DISTRICT

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WATER EFFICIENCY AT THE FARM LEVEL

- Greg Collins
GKC Consulting (Australia)



- Don Cameron
Terranova Ranch



VFD Trial Paramount Farms

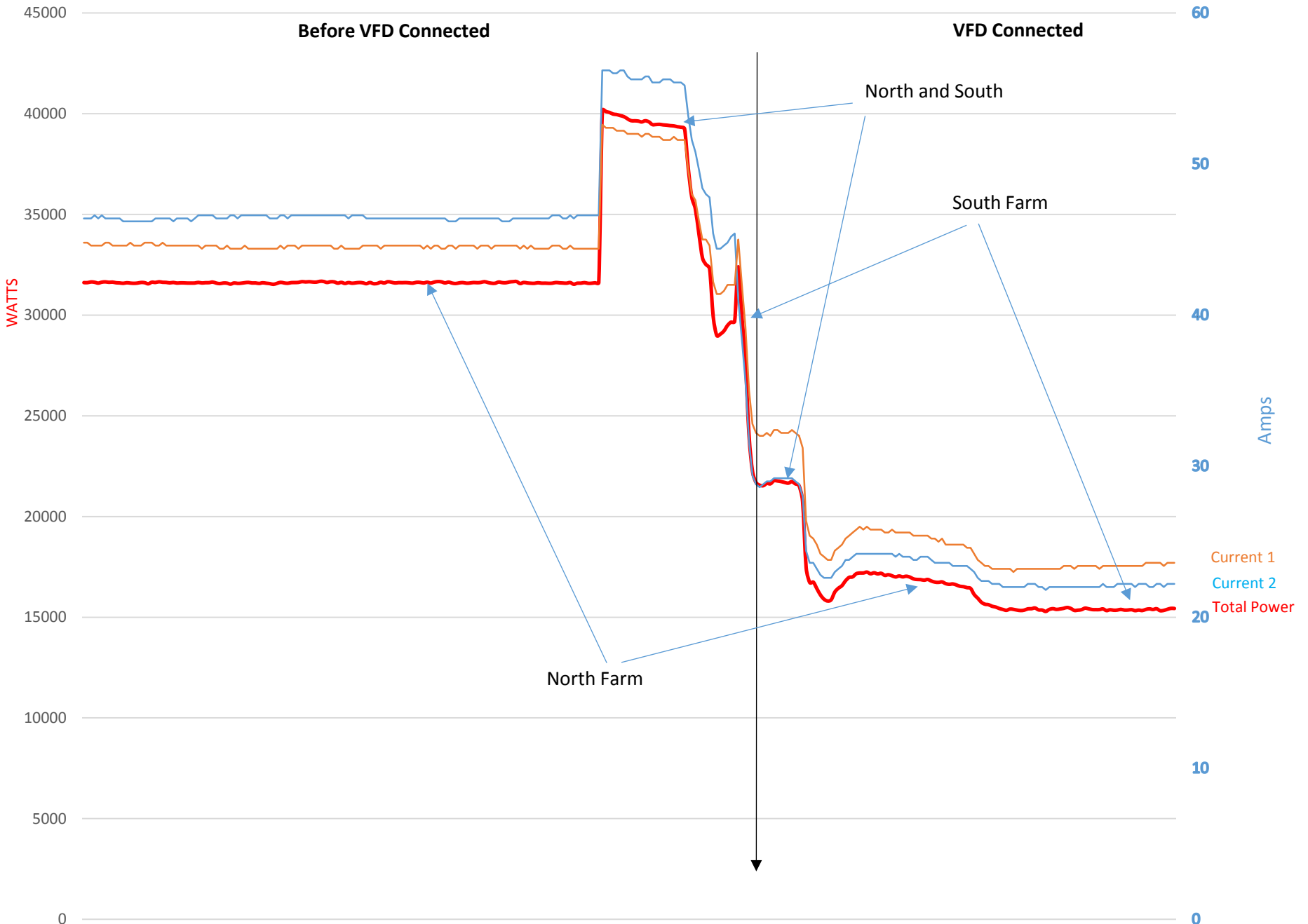
Results Summary

- Installed VFD in 50HP Irrigation pump on farm owned by Paramount farms at Avenue 392 Cutler
- Pump station irrigates 2 farms. North and South.
- Watering can be done in individual blocks or both blocks together.
- Right Energy Solutions matched VFD parameters to required motor load.
- We also the exact irrigation demand by varying pump speed based on required pressure.
- Results show a drop in energy required by nearly 50% across the farms both when

Farm		Before VFD Connected		VFD Connected		% Change	
North	Kilowatts per hour		31.5		16.5		48%
South	Kilowatts per hour		29		15.3		47%
North & South	Kilowatts per hour		39.5		21.6		45%

Current 1

VFD Trial Paramount Farms

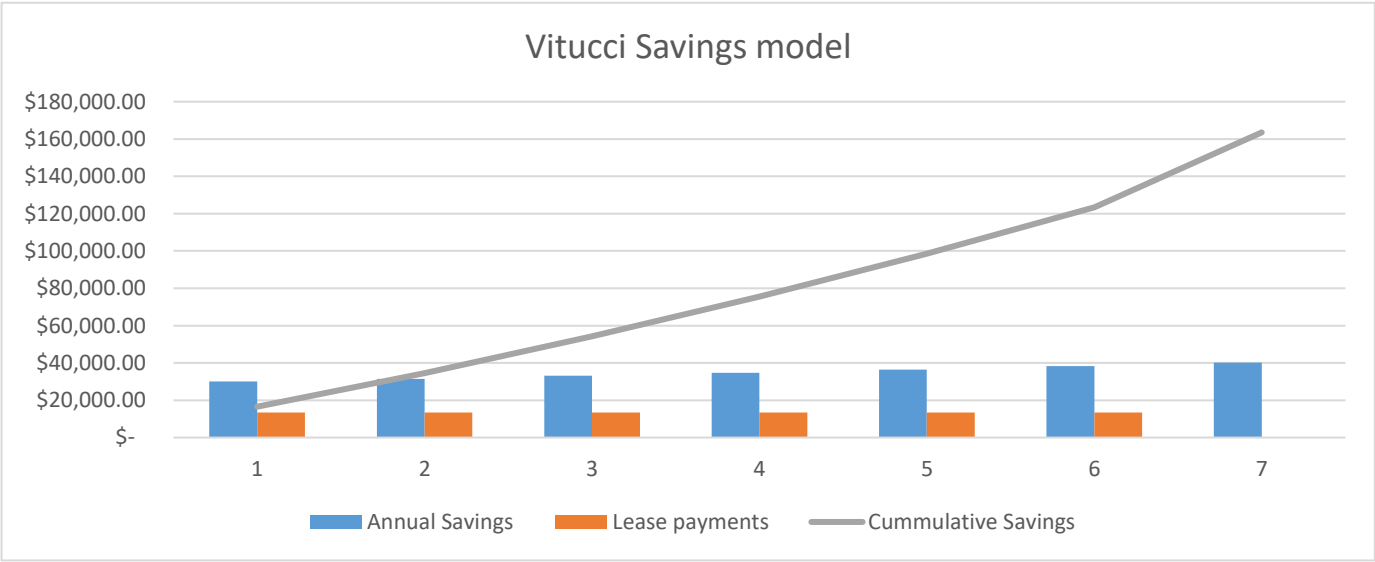


Vitucci

Annual Power bill	\$	100,000.00
Yearly savings	\$	30,000.00
Power price increase		5%
Capital Costs	\$1,121:00	per month

Lease payments Tax deductible

Annual Savings	Lease payments	Cummulative Savings	Annual Savings
\$ 30,000.00	\$ 13,452.00	\$ 16,548.00	\$ 16,548.00
\$ 31,500.00	\$ 13,452.00	\$ 34,596.00	\$ 18,048.00
\$ 33,075.00	\$ 13,452.00	\$ 54,219.00	\$ 19,623.00
\$ 34,728.75	\$ 13,452.00	\$ 75,495.75	\$ 21,276.75
\$ 36,465.19	\$ 13,452.00	\$ 98,508.94	\$ 23,013.19
\$ 38,288.45	\$ 13,452.00	\$ 123,345.38	\$ 24,836.45
\$ 40,202.87	\$ -	\$ 163,548.25	\$ 40,202.87



Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

- Normal operation
 - 18.5Kw motor driving water supply pump to birds and cool cells in 12 of the 24 sheds at farm 60 as well as general water supply to wash down and farm house.
 - The motor at full speed of 50Hz, 415 volts, supplies 110psi of pressure to the sheds which requires reducing to 20psi before entering the birds water supply.
 - 18.5Kw motor required to supply large volume of water under varying conditions driven by both bird age and weather conditions.

Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith

- Operation with Variable speed drive (VSD)
 - Installed 22kw VSD on 18.5Kw motor after 1 month baseline recording of power consumption.
 - Programmed the drive to supply constant pressure of 55psi throughout the network. The large motor still provides the required torque to deliver the volume of water required but now at varying speed
 - Also programmed the drive to run above normal speed of 50Hz to 55Hz to accommodate peak demand – result will be larger volume moved when required.
 - 22Kw drive allows for over run up to 60Hz if required.

Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

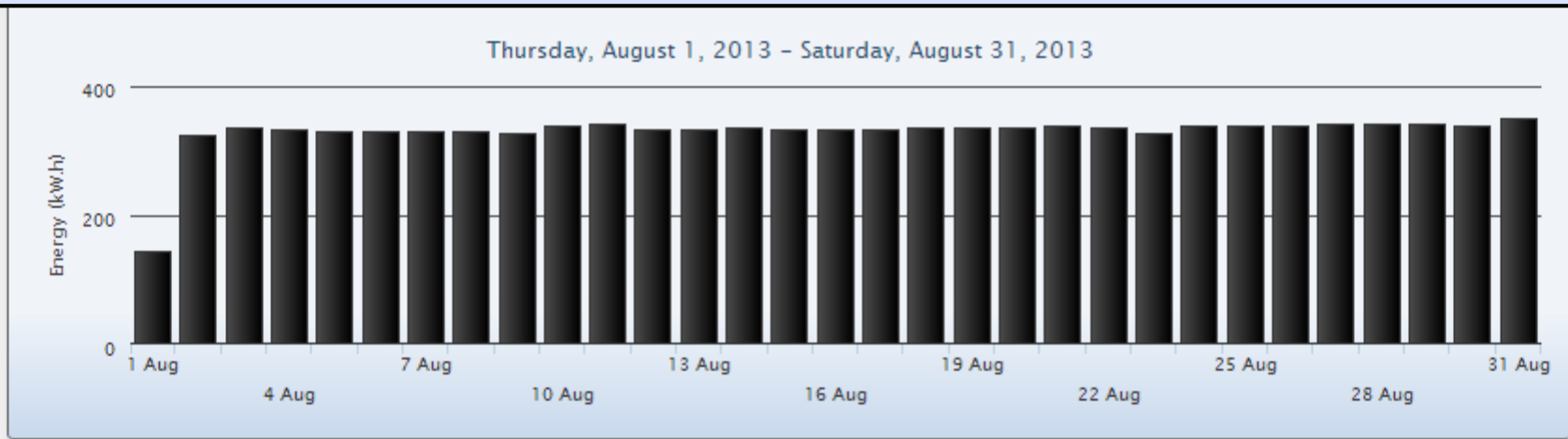
• Observations

- The VSD controlled the motor perfectly supplying constant pressure.
- Readings at each shed showed pressure drop from the motor to the shed was negligible
- VSD failed to restart the motor after standard weekly generator test – Small electrical adjustment required on installation which will ensure motor restart.

We could save more power by reducing the pressure further. We'd need to work closely with Proten staff to determine minimum required pressure at various discharge points. I'd estimate up to 80% during off peak periods

Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

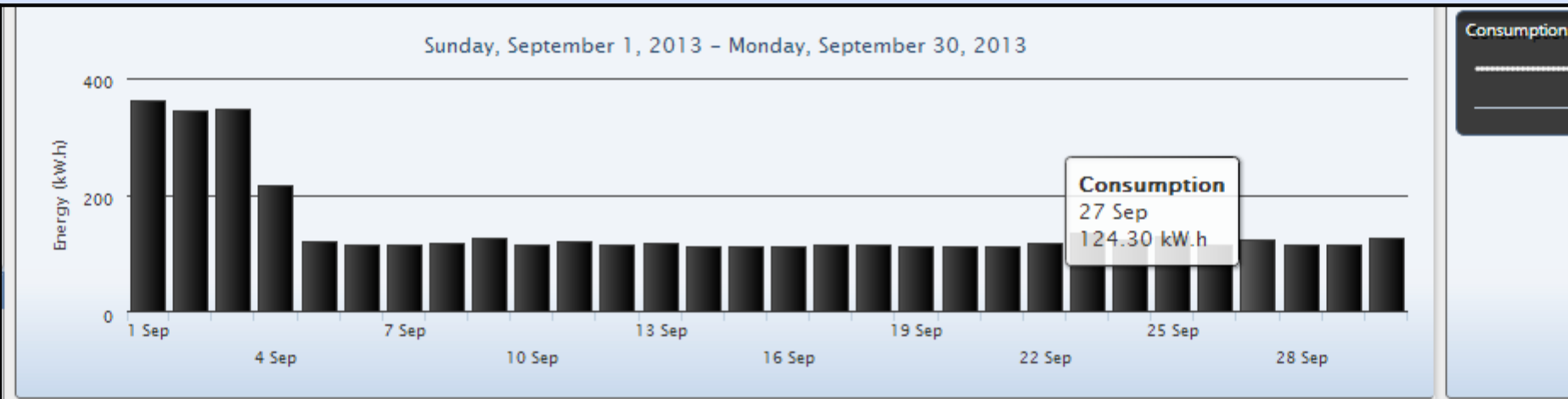


Consumption

Normal operation for 1 month

- 18.5KW motor driving 1 supply pump at Farm 60
- Installed Auzion remote monitoring equipment on August 2.
- Pump performed at full speed with very little variance in power consumption averaging around 330Kw per day
- Pump supplies water to sheds at 110psi which is then reduced to around 20psi at each shed

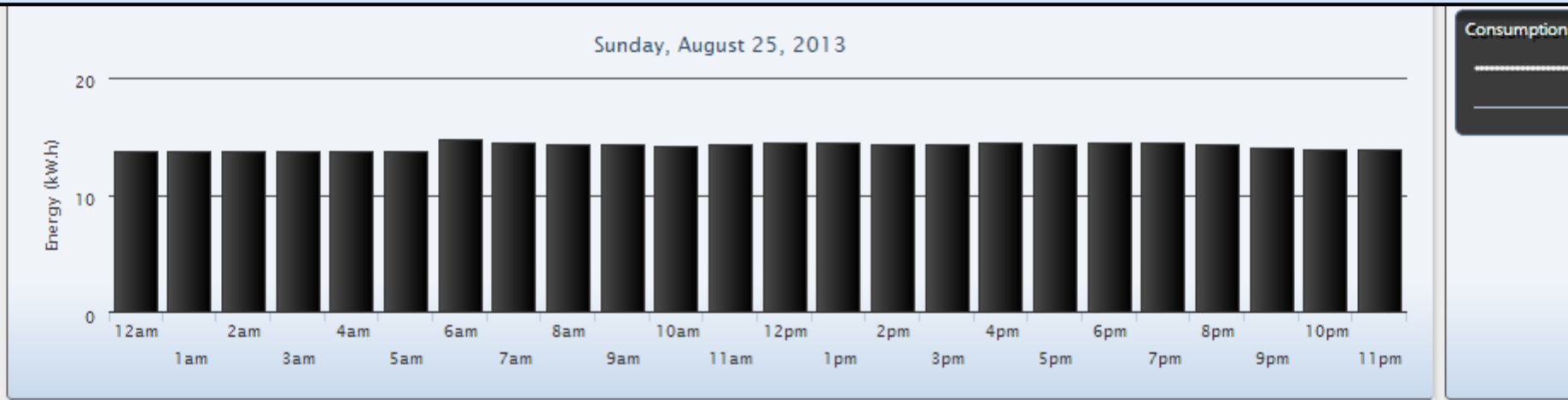
Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith



The same 18.5Kw motor operating with variable speed drive

- Installed Variable speed drive on September 4.
- Controlled motor speed with IFM pressure transducer set to 55psi which was uniformly received at each shed before being reduced to 20psi (normal operation)
- **Significant scope for further saving by reducing the maximum pressure at the Variable speed drive.**
- Motor averaged **120 Kw** per day down from **330Kw**.

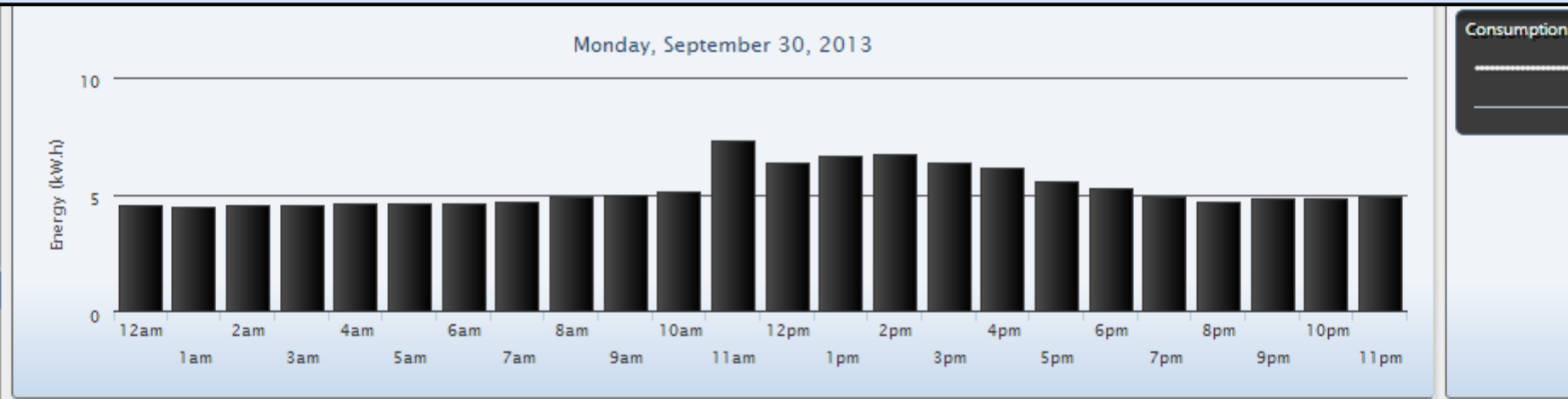
Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith



One day snap shot – normal operation - High temp 17.6 degrees

- High temp **17.6 degrees**
- Birds **3 weeks old**
- Motor full speed

Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith



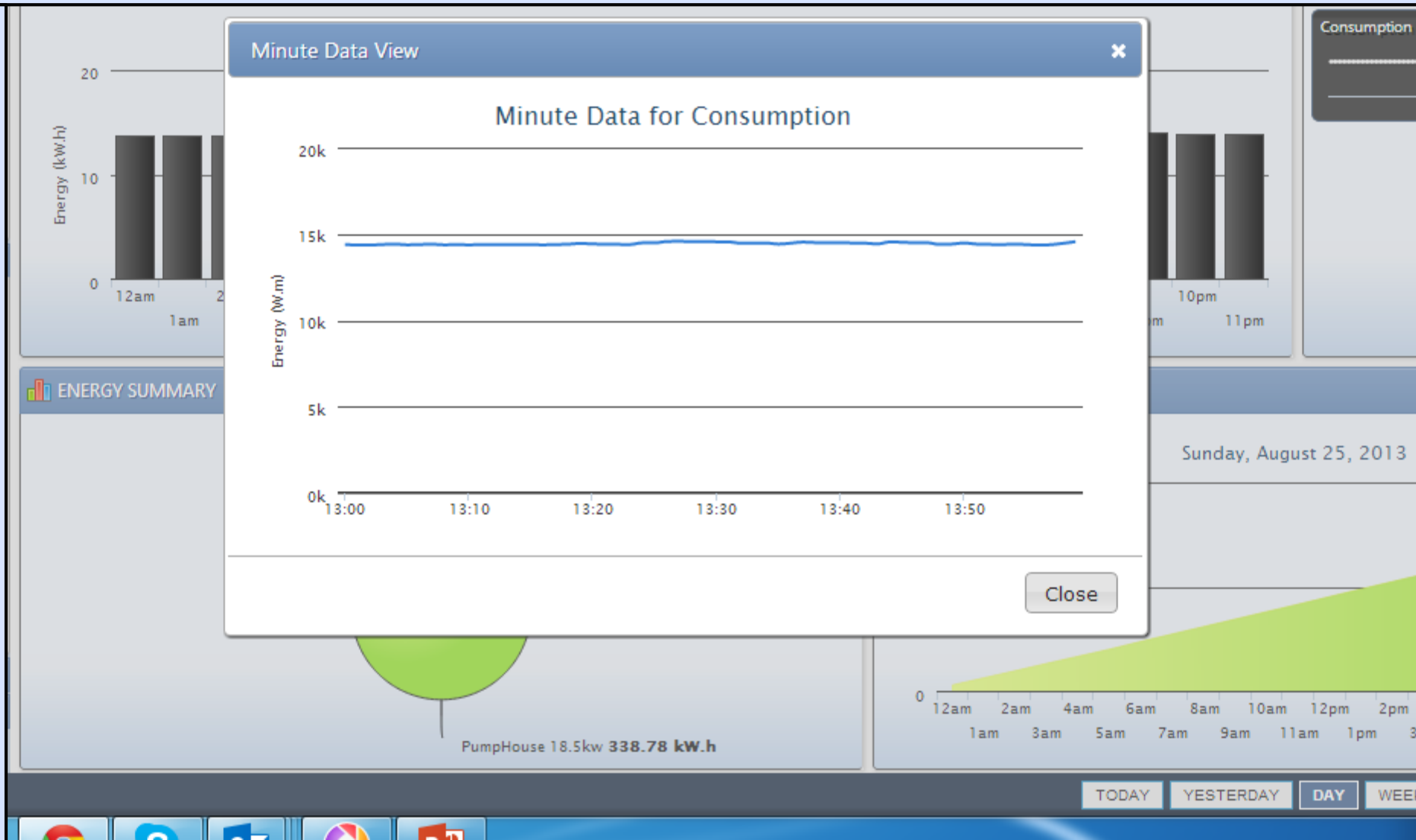
One day snap shot with Variable speed drive on.

- High temp **32.5 degrees** (hottest day of the month)
- Birds **7 weeks +**
- Motor under variable speed delivering appropriate constant pressure of 55psi regardless of demand. Can go as low as 30 psi to provide **much greater saving**.

Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

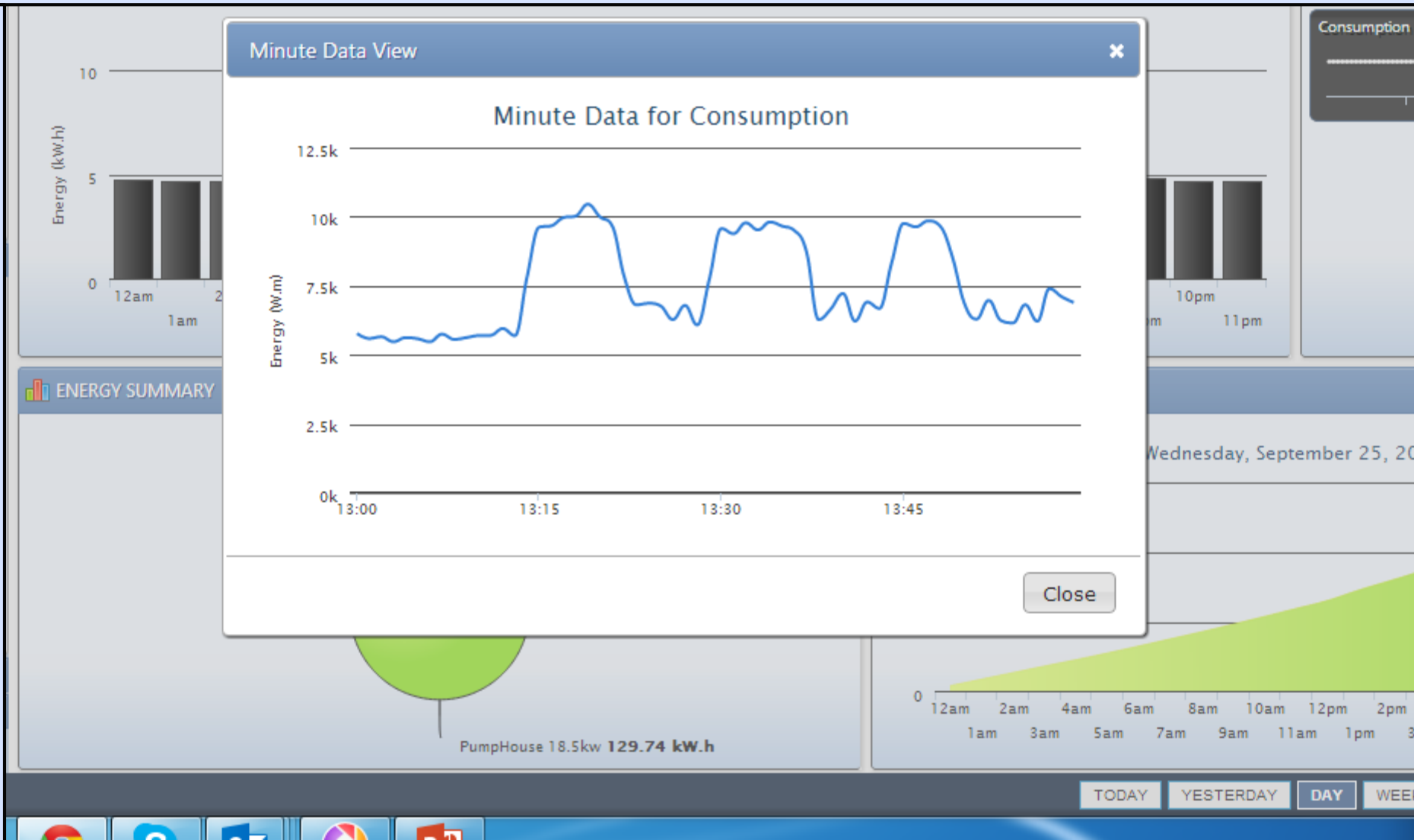
One hour – Normal operation



Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

One hour – Variable speed drive on



Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith

Summary

- Normal operation was recorded from when **new birds** went into the shed and weather was cool, **water demand was low.**
- VSD went on with birds at **3 weeks+** in September which was unusually warm. **Water demand was much higher.**
- Test was done very conservatively. There is room for significantly higher saving
- Annual saving based on the test settings will be in excess of **\$10,000** per year per motor.
- Return on investment well under **10 months.**

Based on average charge of 20 cents per Kwh from July electricity bill for Farm 60

Proten Variable Speed Drive trial Farm 60 Bowditch rd. Griffith

NORMAL OPERATION

- 15Kw per hour = \$3
- 330Kw per day = \$66
- 10,100Kw per month = \$2,020

VARIABLE SPEED DRIVE

- 5Kw per hour = \$1
- 120Kw per day = \$24
- 3,600Kw per month = \$720

- Savings 8 months of the year of around \$1,300 per month
- Summer months will be less but still measurable

Based on average charge of 20 cents per Kwh from July electricity bill for Farm 60

Proten Variable Speed Drive trial

Farm 60 Bowditch rd. Griffith

Quote

- 22kw, LS Variable speed drive \$4,950
- Includes all programming, commissioning, testing, training, steel frame, mounting and installation.
- IFM pressure transducer \$450
- Electrical connection by local contractor \$500 (estimate).
- Electrically compliant enclosure. Cost \$600 each
- 2 year warranty and service.
- Total Cost **1 Unit** \$6,500 +GST
- Total Cost **4 Units** \$22,500 + GST (provided we can access both farms in 2 consecutive days)
- **ROI on 4 units - 6 months.**

On farm Technology: Help or Hindrance

Don Cameron
Terranova Ranch Inc.

[illegible]

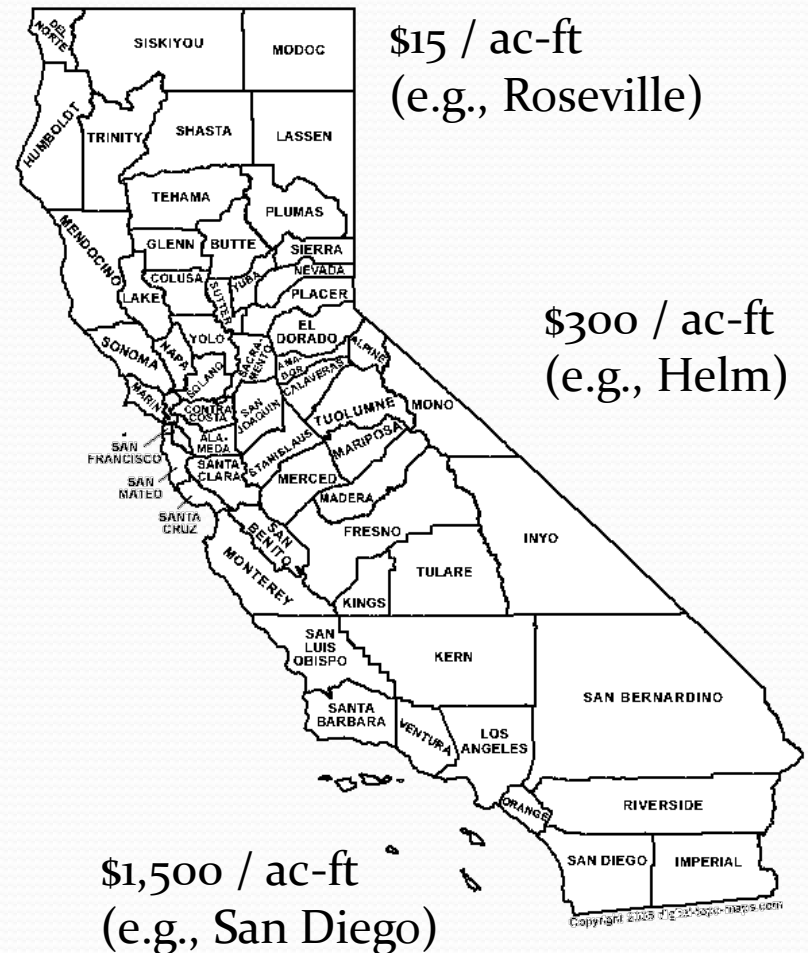
Smart Irrigation Techniques



- All Vegetable Crops Use Subsurface Drip Irrigation
- Onions and Carrots Use High Efficiency Sprinklers.
- All Almonds, Pistachio, Walnut and Wine Grapes Use Above Ground Drip Irrigation
- Zonal Irrigation

Water cost is linked to energy

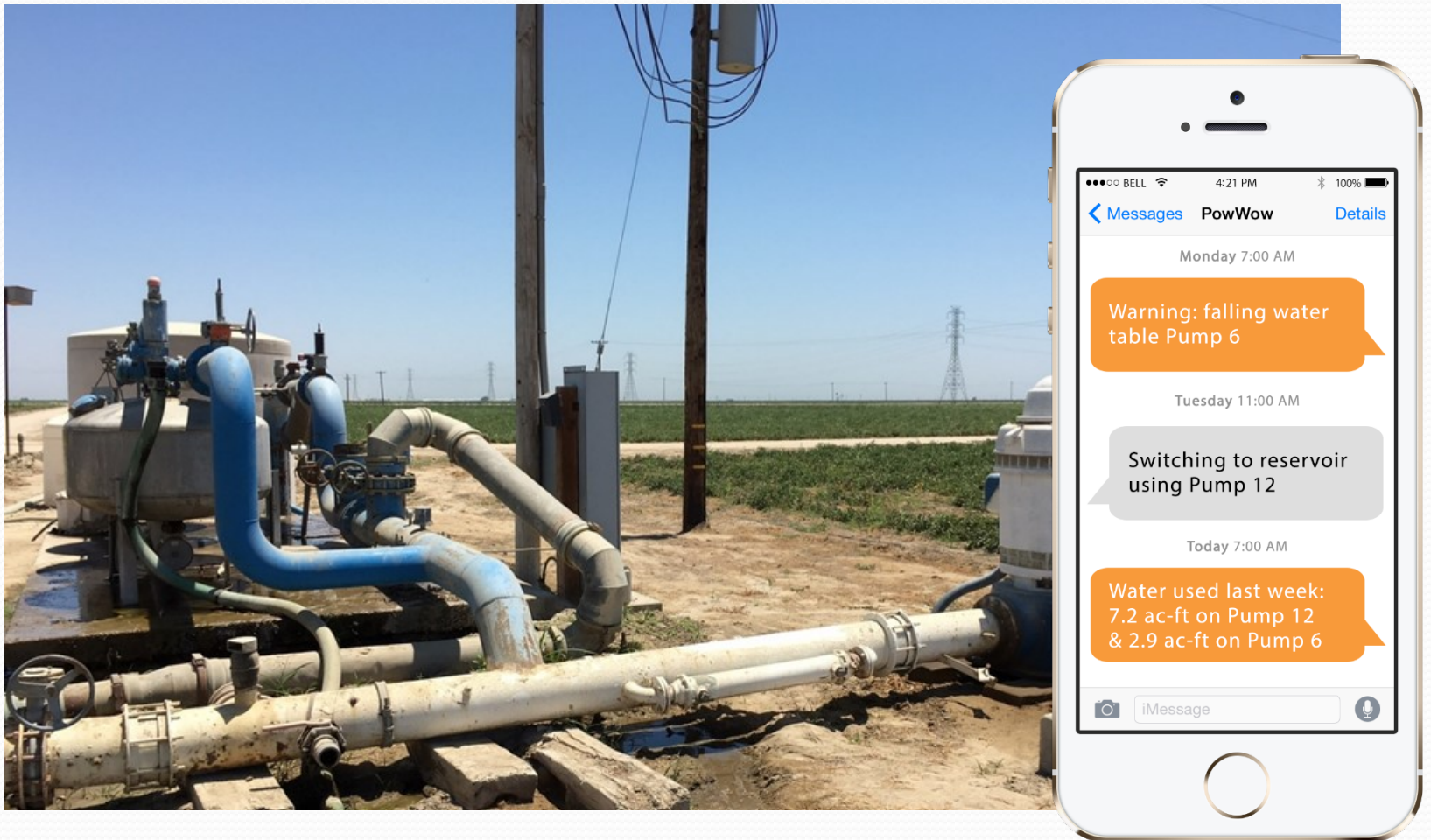
- Water and energy are linked:
 - It takes energy to convey water (surface water) and pump water (groundwater)
 - It takes water to generate electricity
- Cost of water for agriculture varies and depends on energy foot-print to convey water
 - No pump touching water near Sacramento (gravity)
 - Well pumps near Fresno
 - Over 20 pumps touching water to get to San Diego



Project with smart meters



Help: information, not data



Example of pump alerts

Leak (Roseville)

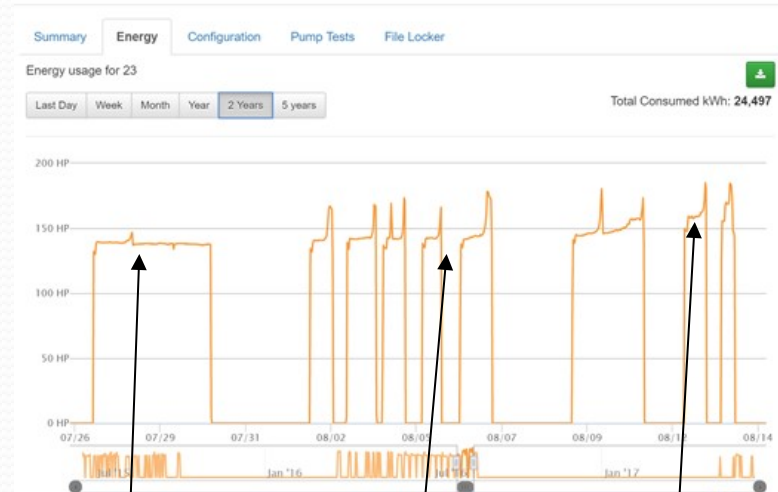
Filter clogs (Helm)



Early leak

Big leak

Leak fixed



Clog

More clogs

Filter clogs over
running pump

Water measurement

Can we use smart meter?

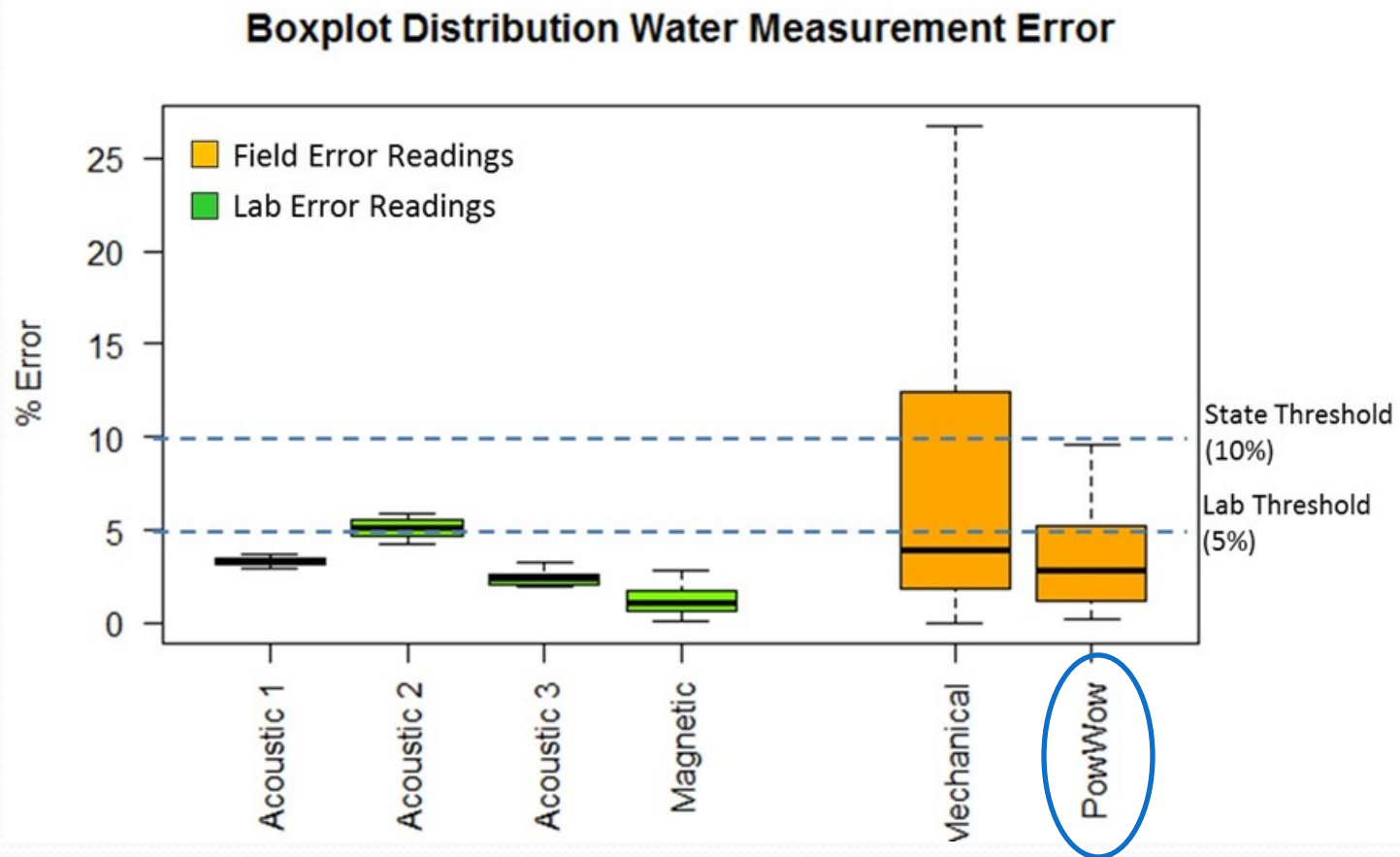
- Yes but pressure and pump efficiency change over time
- Relationship between energy and water use is not constant
- High-frequency data and algorithms (PowWow) can be used to track water use
- Study funded by California Energy Commission under contract EPC-14-081

Test on 20 pumps in 6 basins



Source: UCSB

Comparison of accuracy



Source: UCSB

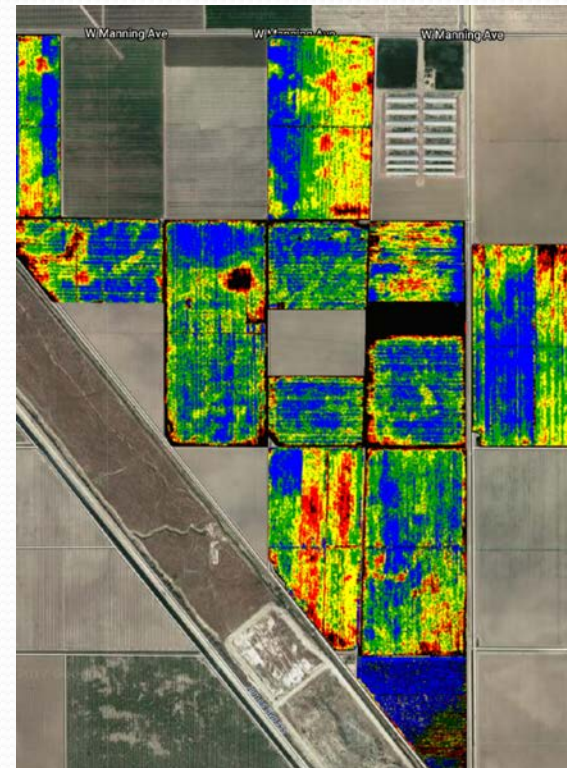
Other useful technologies

On-farm weather station



Source: DTN

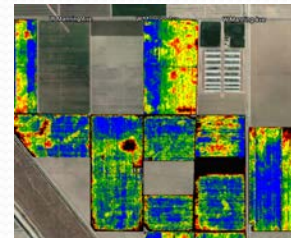
Aerial images



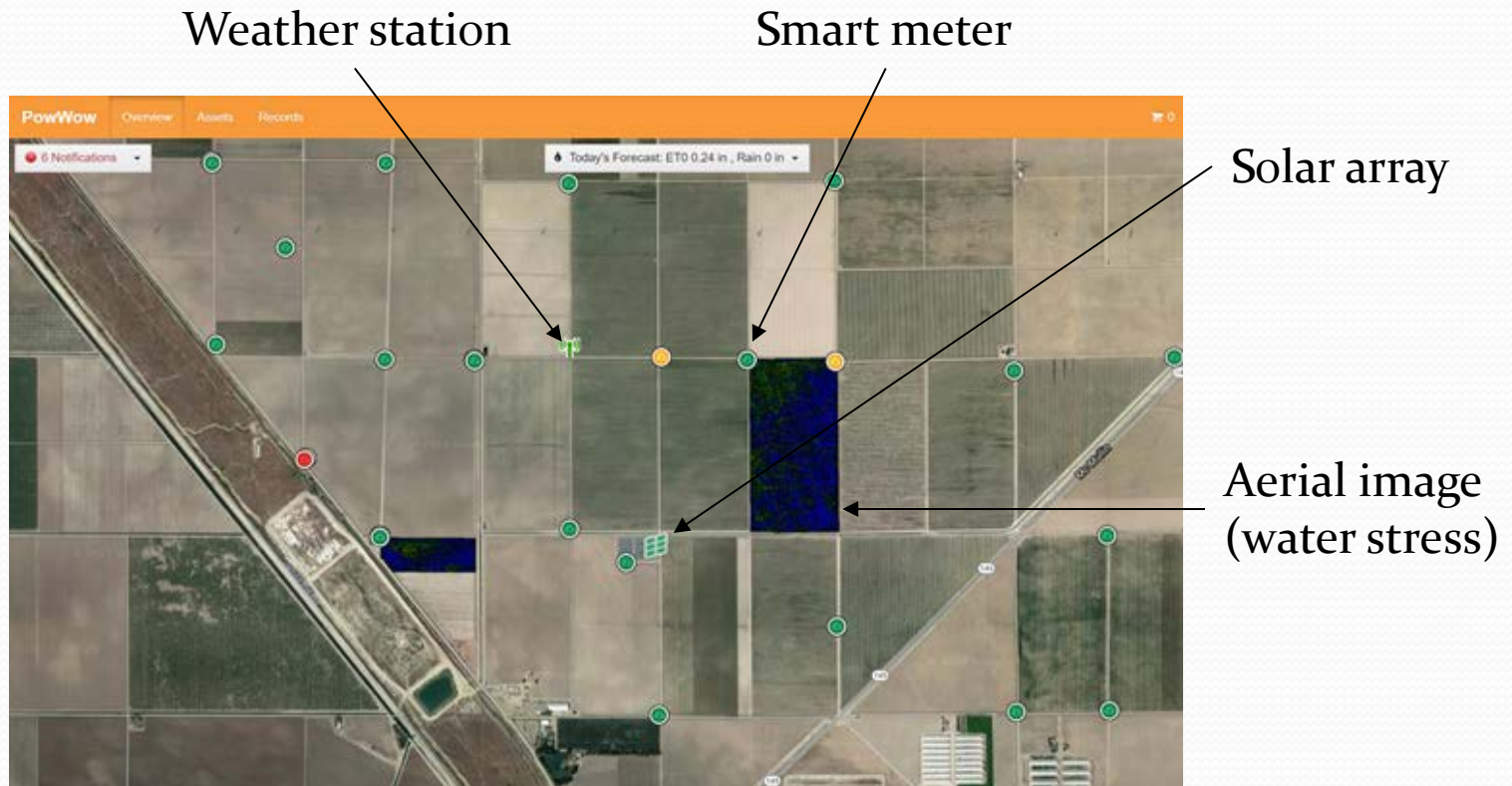
Source: Ceres Imaging

Hindrance: integration of data

I don't have time to look at data on multiple apps

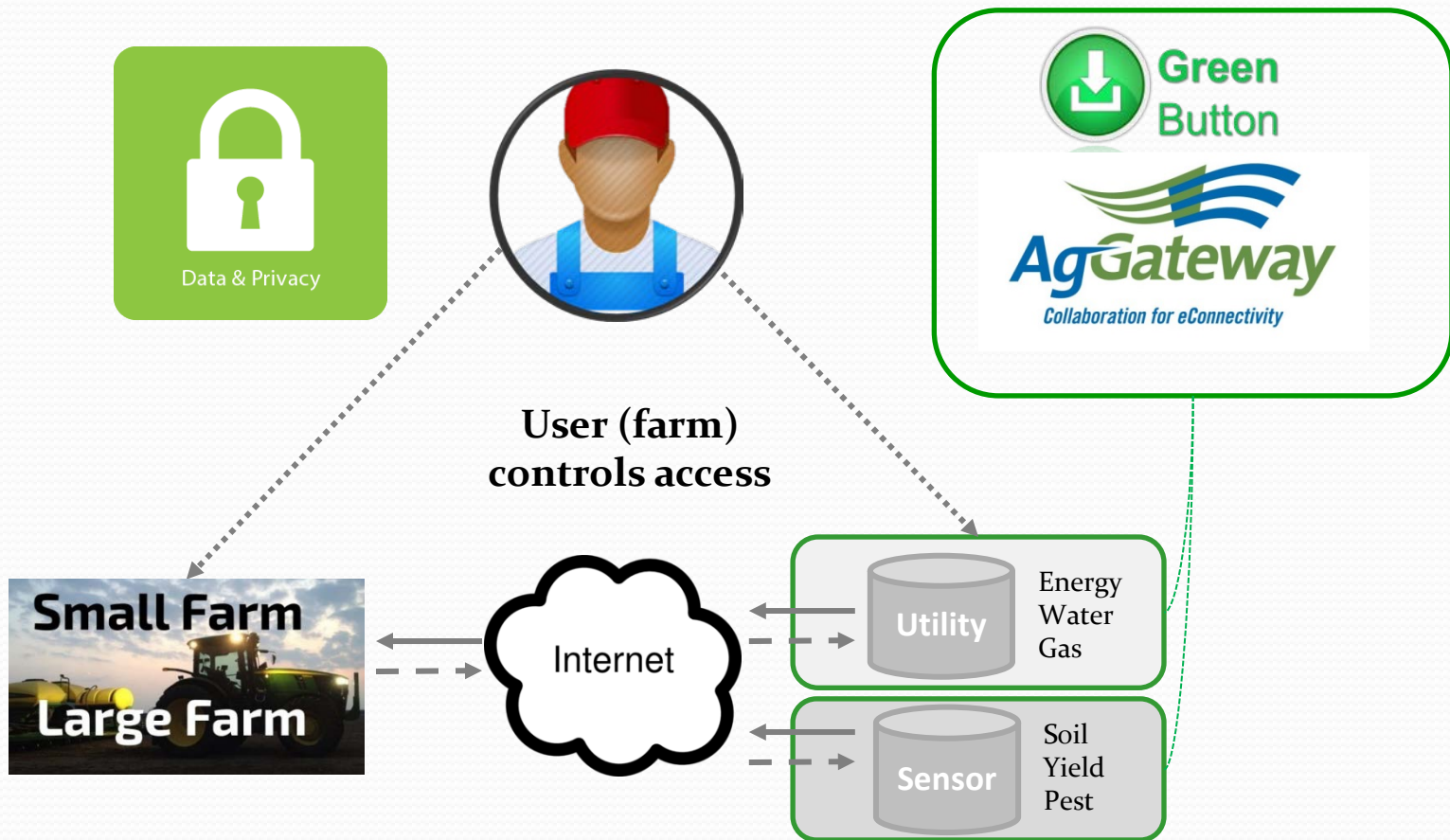


Prototype to integrate data



Source: PowWow Energy

Privacy: standards are critical



What's Driving the Change?

- Five Years of Drought
- Sustainable Groundwater Management
- Increased Pricing
- Decreased Availability
- More Valuable Crops





Thank You

Questions?

CALIFORNIA & AUSTRALIA CLIMATE SMART AGRICULTURE

Webinar: Irrigation Water Management and Technologies - a focus on specialty crops.

Monday, June 19, 2017, 3:30 — 5:00 p.m. PST (California) • Tuesday, June 20, 2017, 8:30 — 10:00 a.m. AEST (Australia)



Agenda & Speakers

Welcoming/Opening Remarks

- Amrith Gunasekara, California Department of Food and Agriculture
- Chris Oldfield, Consul General & Senior Trade Commissioner – Australian Trade Commission (San Francisco)
- Steven Ostoja, USDA Climate Hub

Water Distribution Experiences During Drought (Australian & California)

- Richard McLoughlin, Australian Department of Agriculture and Water Resources
- Kamyar Guivetchi, California

Water Efficiency at the Delivery and Distribution Level

- John Culleton, Coleambally Irrigation Co-operative Limited
- Peter Rietkerk, South San Joaquin Irrigation District

Water Efficiency at the Farm Level

- Greg Collins, GKC Consulting (Australia)
- Don Cameron, Terranova Ranch

Audience Questions/Discussion